TRESTLE OVER McCOY'S CREEK, FLA.

BY W. B. W. HOWE, JR.

[Written for ENGINEERING NEWS.]

The Waycross Short Line, which was opened to the public about a year ago by the Savannah, Florida & Western Railway, presented during the construction but few features of engineering interest, traversing, as it does, a pine barren, almost unbroken, from Waycross, Georgia, to Jacksonville, Florida.

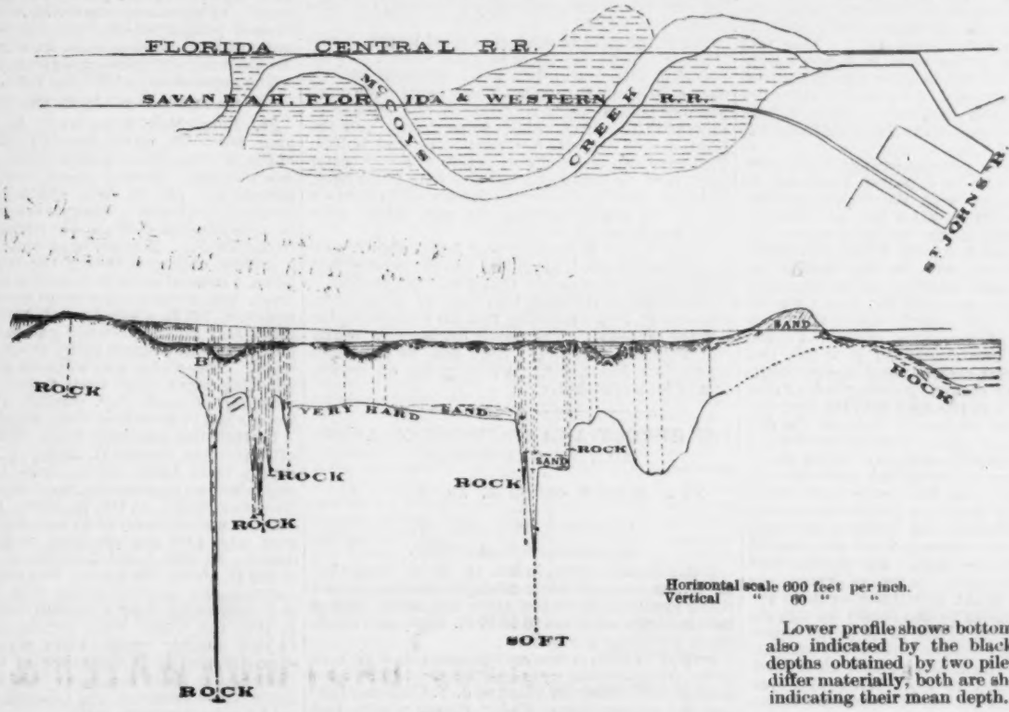
I have frequently heard it remarked, in speaking of the numerous projected lines of railroad which traverse the map of Florida, and afford a never-ceasing source of wonderment to the more conservative railroad men of the country, that their construction would consist chiefly in laying the cross-ties and iron, and digging a side ditch or two. This sounds refreshing when contrasted with construction in a rocky, or what might be called a "hard country," but however true it may be in many cases, particularly on projected roads with limited capital, it would be wiser to acquaint ourselves with the special characteristics of the locality before assuming that in escaping the difficulties presented by one extreme we will not encounter those of the other. The following remarks, based on my field notes, are not intended to illustrate railroad building in Florida, but only to present to your readers certain peculiarities of a Florida marsh which were brought to my observation while engineer for the construction of a portion of the Waycross Short Line, together with the methods adapted for overcoming the difficulties presented.

The location selected for the terminus of the Waycross Short Line, at Jacksonville, Fla., was on the left bank of the Saint Johns River, at the mouth of McCoy's Creek, the approach to which could only be effected over this creek and its adjacent marshes. By referring to the accompanying map, it will be seen that in the distance of less than a half-mile the located line crosses the creek three times. Considerable difficulty was apprehended in the construction of this portion of the line, as it was known that the piles which carry the Florida Central Railroad trestle had been driven to the depth of 80 ft. without reaching bottom. In this case the difficulty of foundations had been overcome by increasing the number of piles and introducing intermediate bents, so that in the finished trestle the spans varied from 6 to 15 ft., which gave to the whole an exceedingly slovenly and patched-up appearance, and must also have proved an expensive method of construction.

The difficulties presented in the construction of the Waycross Short Line had to be overcome in a more systematic manner. Three methods presented for consideration. The first, to build a bank on mattrasses across the marsh; the second to construct a permanent trestle, and the third, to build a temporary trestle which would be filled in by trains before renewal was necessary. The first proposition was inexpedient in view of the time required for its execution and the lack of filling material available. The second would involve unnecessary expense if the intention of filling in was carried out within a reasonable time. The third proposition was therefore decided upon as most expedient. The general character of this trestle is shown in Figs. 1 and 2, and consisted of bents 12′ 6″ between centers, each bent being formed of two round piles 6′ 6″ between centers and capped with double caps, the lower 10″×12″, mortised and tenoned to piles, and the upper, or shimming cap, 4″×12″, pinned to the lower cap with three 1½″ wooden pins. Each bent was also braced transversely with X braces of 3″ plank spiked to the piles. The stringers which spanned the spaces between the bents were 12″×14″, notched one inch on to cap, which was also notched an inch to receive stringer. These stringers broke joint and were pinned to the caps except at the crossings of the creek, where they were spliced with 2″ plank, bolted on.

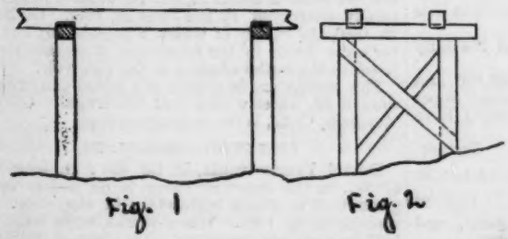
The difficulties in the way of building any kind of trestle over a marsh as soft as the one in question consist principally in the transportation of the machinery and material. These must be handled on a tramway or on skids, the shifting of which from place to place is an item of expense which amounts to a considerable proportion of the cost of the whole. In the case under consideration, the difficulties were enhanced by the three crossings of the creek, where it would be impracticable to transport the machine on skids, and where it would be necessary to transfer the pile driver to a lighter from which it could be operated.

There was, very fortunately, available just at this time a large steam pile-driver which had been constructed for work of a similar character on another part of the line. This machine, an idea of which may be had from Figs. 3 and 4, consisted of a carriage 50′ long, composed of two runners of 12″×13″ timber firmly braced laterally and shod on the under side with bars of railroad iron. Upon one end of the carriage was built a platform, upon which the engine was located, and upon the other the hammer-guides and customary framing were placed. The whole was arranged to operate two hammers, each 1,900 lbs. in weight, and as the guides were placed 6′ 6″ between centers, both piles of a bent could be driven without changing the position of the machine. The framing and counterpoising was so adjusted that the iron shoes on the bottom of the runners would rest in grooved rollers placed on the heads of the piles already driven, the hammer frames projecting beyond the last bent to the site of the next; in this position the weight of the projecting portion was counterpoised by the weight of the engine and frame behind the last bent. The piles for the new bent having been driven were cut off

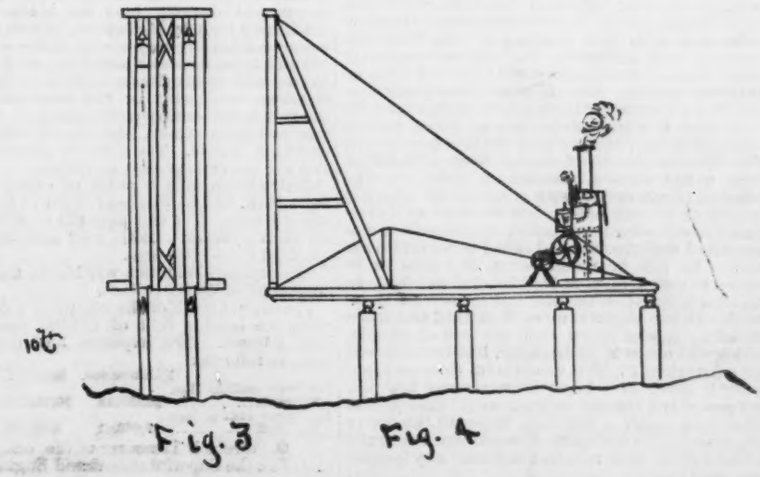


Horizontal scale 600 feet per inch.
Vertical " 60 " "

Lower profile shows bottoms of piles, which are also indicated by the black dots. Where the depths obtained by two piles of the same bent differ materially, both are shown, the profile line indicating their mean depth.



Scale, 10 feet per inch.



Scale, 20 feet per inch.

at the proper height, rollers put upon them and the machine hauled ahead by attaching a line from the hoisting drum to one of the piles, under the forward part of the carriage. One of the peculiar advantages of this machine, as will be seen, was that it required no skids or scaffolding for its transportation except the X braces and stays to hold the head of the pile steady while it was moving ahead. It would also cross the creek as easily as the marsh.

The locomotives in use on the Savannah, Florida & Western Railroad would concentrate a weight of slightly more than 18,000 lbs. on each pile, and it was deemed of great importance to have these reach a firm bearing. The specification, therefore, required that each pile should be driven until the average settlement per blow during the last three blows of the hammer, under the full fall of 25′, should not exceed 1½″. This was adhered to throughout the work, with the exception of a few instances where quite a thick stratum of sand was encountered, into which the piles penetrated with great difficulty. Here it was thought they would possess considerable frictional stability.

The first pile driven gave no evidence that anything unusual was to be expected, receiving 30 blows and bringing up with the required settlement at a depth of 14 ft. The 30th pile was the first which gave indications that more or less difficulty was to be encountered. From this point, as will be seen by reference to the section, the piles increase in length, reaching the maximum at the 34th pile, which received 293 blows and attained a depth of 134′ and 6″ (134.5 ft.) This pile was composed of 9 sections, connected at the joints with round iron dowells, 1½″ × 12″, and was driven with great care, as there was considerable danger of one section jumping off of that below it. So soft was the mud that the first section of a pile would frequently descend the full length of the hammer guides without receiving a blow, and it was found necessary to put check chains on the hammers to prevent their moving out of the guides and being lost in the mud. After driving the second section of a pile the settlement would become comparatively uniform for each blow until bottom was reached, when the descent would be abruptly checked. So sudden and marked was this change in the rate of descent per blow that I felt no doubt in attributing it to the presence of rock similar to that found at varying depths in several borings I had made in the immediate vicinity, and which proved to be a very compact white marl, which in the mineralogical scale of hardness would correspond to 2½. Where this rock was exposed upon the bottom of the river with no overlying mud, it became necessary for the piles to be driven some distance into it to obtain the requisite steadiness. To accomplish this, they had to be shod with iron points, and even then were handled with difficulty. The rock was evidently much fissured, and cracks could be found with an ordinary probing rod. It would frequently happen that a pile after having been driven into the rock 8′ or 4′ would strike one of these fissures and spring completely out of the hammer guides. The piles for the wharf in the river were driven from a flat with a hammer of 2,240 lbs. The effect of this hammer with a fall of 25′ on a pile resting on an unyielding bottom was well illustrated in one which was pulled up, because it was suspected that the shoe had failed to penetrate the rock. As will be remembered, the piles to be driven to a settlement of 1½″ for the last blow. In the case in question the pile had for several blows been settling slightly more than this, and when pulled up it was found that the end of the pile, which was about 9″ in diameter, had been browed for a length of 3′. This would seem to be an argument in favor of a heavy hammer and low fall, and probably a heavier hammer would have proved efficacious under a low fall; but with the one in use, after trying both plans it was found that quite a heavy blow was required to make any impression whatsoever.

But to return to the long pile above-mentioned, it may not be amiss to remark here that it was driven half on one day and so left over night. When work was resumed the next morning careful observations were made to ascertain whether the friction upon its sides had increased at all during its static condition, as had been recorded in the case of other long piles, but no difference could be detected in the settlement per blow from that produced by the last blow of the previous day.

Were all the piles to be as deep as this it was evident the cost of the work would be proportionately large. The device, therefore, was tried of increasing the bearing surface of each pile by bolting to it a platform of timber 4′ square. The platform was made by bolting on each side of the pile one piece of 6″ × 12″ timber 4′ long and placing beneath them 3″ plank 4′ long at right angles to the pieces of timber. When the pile was driven this was forced down into the mud. The pile at *B* carries one of these platforms on its second section.

It had been observed that at about 30′ below the surface a more or less compact stratum was encountered, but which was so thin that the piles would penetrate it and pass into soft material below. The object of the platform was only as an auxiliary support, so that it became necessary to ascertain the depth of the stratum at the position of each pile, and locate the platform so that it would not bring the pile to a stand until it had reached the stratum referred to, while at the same time it should oppose further settlement. This was determined with an ordinary gas pipe sounding rod, which could be forced down to the hard surface, but not through it, so compact was the material. The platform device worked well, but was only used in a few instances, as the stratum referred to increased in strength in the distance of the next two bents sufficiently to prevent the piles pushing through.

While the piles were of such great length it was thought best to stay them by some means. To accomplish this four bents were selected, two on each side of the long piles. These bents were composed of piles of single sections; on the outside of each of them single piles were driven, and the heads driven in under the bent caps and bolted. This gave two bents of two plumb and two batter piles, each on either side of the long pillar bent. Between these and over the intermediate bents a system of lateral bracing was run, which gave great steadiness to the whole.

Longitudinal X bracing was introduced wherever it would avail anything, but the greater part of the trestle was so low that it was not needed.

The whole of the work was done by day's labor, and cost $1.92 per running foot for everything below the cross-ties. The trestle has been in use by freight trains since Oct. 1, 1881, and by passenger trains since Jan. 1, 1882, and has given no indication of lack of stability.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.

Continued from page 131.

CCLXXXIV.—CEDAR RAPIDS.

Cedar Rapids, Iowa, in lat. 41° 58′ N., long. 91° 40′ W., on Cedar River, is on slightly rolling ground rising gradually from the river for about half a mile to bluffs of from 25 to 50 ft. high, on which many dwellings are built.

Settled in 1839, it was incorporated as a city in 1856. Water-works were built by a private company in 1875, after the plans of J. T. Cushing, taking the supply from Cedar River, which has a water-shed of about 700 square miles. The water is pumped directly into the mains by steam machinery built by McGowan. There is one compound condensing engine with steam cylinders of 26½ and 28-in. diameter and 30-in. stroke, and one engine with 16-in cylinder of 24-in. stroke, operated either as condensing or non condensing. There are two double-acting piston pumps of 13-in. diameter and 30-in. stroke, and two of 10-in. diameter and 24-in. stroke. The ordinary pressure is 60 lbs. and the fire pressure 800 to 100 lbs.

Distribution is by 8 miles of cast-iron pipe of from 16-in. to 4-in. diameter, with 76 fire hydrants and 375 taps. The city pays $75 to $100 per year for each hydrant. Both lead and wrought iron are used for service pipe.

The population in 1880 was 10,104, and the daily consumption 550,000 gallons.

The capital stock of the company is $66,000, and there is a bonded debt of $65,000, bearing 8 per cent. interest. The expenses and receipts have been as follows:

	Maintenance.	Interest.	Receipts.
For year ending Mar. 31, 1881	$6,493.43	$6,162.73	$14,536.61
For year ending Mar 31, 1882	7,063.41	6,065.04	15,877.22

F. O. Weeks is Treasurer of the company, and C. J. Fox the Superintendent and Engineer.

CCLXXXV.—ANDES.

Andes, New York, in lat. 42° 12′ N., long. 74° 42′ W., is on Tremper's Kill, a small stream in a hilly country. Settled about 1817, it was incorporated as a village in 1861 and re-incorporated in 1879.

Water-works were built by a private company in 1876, under the superintendence of Thomas S. Miller.

The supply is taken from two springs which issue from opposite sides of a large rock, and yields about 140,000 gallons per day. The streams unite below the rock, and the water is led 12 ft. through a 6-in. pipe, over the wall of a reservoir 50 ft. square and 8 ft. deep, formed by a wall of stone laid in cement and blue clay, 4 ft. wide at bottom and 2 ft. at top. The reservoir is 160 ft. above the village, to which the water is conveyed through a 6-in. cast-iron pipe which is laid under the lower wall and across the bottom of the reservoir to the influent pipe.

Distribution is by 1½ miles of 6-in. and 8-in. cast-iron pipe, with 20 fire hydrants, 4 gates and 100 taps. The village exempts the company from taxation, in consideration of the use of water for fires. Lead service pipes are used.

The population in 1880 was 496 and the daily consumption 3,000 gallons. The capital stock of the company is $6,000. The works have cost to the present time $7,000 and the receipts have been $2,300. There is no debt. The expenses in 1880 were $25 and the receipts $380.

Barua Johnson is Secretary and Treasurer and Thomas S. Miller Superintendent.

CCLXXXVI.—LEROY.

Leroy, New York, in lat. 42° 57′ N., long. 78° 6′ W., is on Oatka Creek, which supplies a fine water-power.

In 1875 water-works for fire protection only were built by the village, taking the supply from the creek. Two water wheels in a mill drive 2 La France pumps which force the water through 2 miles of 6-in. cast-iron pipe, with 20 fire hydrants. No financial statements are given.

The population in 1880 was 1,468.

CCLXXXVII.—ST. JOHN AND PORTLAND.

St. John, New Brunswick, in lat. 45° 10′ N., long. 66° 5′ W., on the Bay of Fundy at the mouth of the St. John River is on a rocky peninsula with steep slopes. Settled about 1780, it was incorporated as a city in 1785. Portland, of later settlement, and under a separate municipal organization, adjoins St. John, and is supplied with water from that city. Water-works were built in 1836 by a private company, taking the supply from Lily Lake, a natural pond 80 ft. above the base of city levels and about 2 miles from the city. Leinster reservoir, 143 ft. above base of levels, built of masonry and holding 300,000 gallons, was filled by pumping with a steam pump three or four times a week. The water was allowed to enter the distributing pipes only from 6 to 8 o'clock in the morning of each day, during which time consumers had to draw their daily supply.

In 1849 the company built additional works, after plans of George H. Bailey, C. E., taking the supply from Little River, about 4 miles from the city, where an impounding reservoir of 37½ acres area was constructed at 160 ft. above the city datum, and the water conveyed to the city in a 12-in. cast-iron pipe, and the pumping works were abandoned. In 1851, Lake Latimer, of 200 acres area, at 300 ft. above city datum, was made available by damming its natural outlet into Mispeck River, and connecting it by a conduit with Little River. In 1855 the works were purchased by the city. In 1857 another supply main was laid, of 24-in. diameter, and in 1873 another of 24-in. diameter. The regular daily supply is now taken from the Little River reservoir, the Leinster reservoir being used for fire purposes only.

Distribution is by cast-iron pipe of from 15-in. to 3-in. diameter. There 32.15 miles in use, with 276 fire hydrants, 49 free hydrants for the use of the poor, 671 gates, 3,733 taps, and 121 meters. Lead pipe is used for all services of 1 in. or less diameter.

The total cost of the works to Jan. 1, 1882, was $987,471.50. This includes interest and maintenance.

The cost of maintenance and repairs in 1881 was $12,844. The revenue from "agreement customers" was $9,279.33 and the assessment on property for water purposes was $68,099.90. The population of the two cities is about 32,000. St. John was almost totally destroyed by fire June 20, 1877. On Nov. 22, 1880, the supply of water was suddenly cut off for some hours by the formation of anchor ice or *frasil* in the outlet chamer at the reservoir.

The works are in charge of a board of commissioners of water-works and sewerage. Gilbert Murdoch, C. E., is the Superintendent.

CCLXXXVIII.—BRISTOL, PA.

Bristol, Pennsylvania, in lat. 40° 7′ N., long. 74° 47′ W., on the Delaware River, is on nearly level ground, 12 ft. above high water in the river. It was settled in 1684. Water-works were built in 1875 by a private company, after plans of William E. Morris, taking the supply from the Delaware River and pumping it by two Worthington duplex steam-pumps of 16-in. steam and 10-in. water cylinders into a stand-pipe 6 ft. in diameter and 140 ft. high.

Distribution is by 3½ miles of cast-iron pipe of from 12 to 4-in. diameter, with 280 taps. There are no fire hydrants. Service pipes are of lead.

The population in 1880 was 5,474. The daily consumption is 130,000 gallons, about two-thirds of which is used by the locomotives of the Pennsylvania Railroad.

The original cost of the works was $39,450, and $4,500 have since been spent in extensions. There is no debt.

The receipts and expenses since May, 1878, have been as follows:

	Receipts.	Expenses.
Year ending May, 1879	$5,414.67	$2,968.53
" " " 1880	5,650.13	2,220.85
" " " 1881	6,026.39	2,710.98

Anthony Swain is President of the company, Anthony K. Joyce the Superintendent, and G. M. Dorrance the Clerk.

CCLXXXIX.—BETHLEHEM.

Bethlehem, Pennsylvania, in lat. 40° 36′ 24″ N., long. 76° 56′ 8″ W., is on the northeast fork of the Lehigh River and Monoquacy Creek, on high and uneven land. It was settled in 1741 and incorporated as a borough in 1845.

Water-works were built in 1754, by Hans Christopher Christiansen, a millwright and a native of Denmark. These are believed to have been the first works for public water supply built in the United States. The water was taken from a spring issuing from magnesian limestone, near the banks of the Menogassi Creek, as it was then called.

The water was conducted 350 ft. through an under conduit into a cistern, whence it was pumped by a lignum vitæ pump of 5-in. bore, through bored hemlock logs, to a height of 70 ft., into a wooden tank in the village square. Trouble was experienced from the bursting of the pipes, and 1¼-in. pipes of sheet lead, soldered along the edges and bedded in a cement of pitch and brick dust and laid in a gutter of brick were tried without much success.

In 1762, Christiansen, aided by John Arbo and Marshall, constructed larger works. An 18-ft. undershot wheel drove three single-acting force pumps of iron of 4-in. bore and 18-in. stroke. The force main was of gum wood and the distributing pipes of pitch pine. The latter had to be renewed in 1769. In 1786 lead pipes were substituted for the gum wood force main and for most of the distributing pipes. The last pitch pine pipes were abandoned in 1791.

The reservoir was a wooden tower in the "little square." This was removed in 1803 and a stone tower built on Market street, about 15 ft. high, in which was a tank at an elevation of 112 ft. above the spring. A reservoir 70 ft. long, 10 ft. wide and 7 ft. deep was built in 1817. In 1832 another reservoir was constructed on higher ground and the water tower abandoned. In 1832 the triple pumps were replaced by one double-acting pump. In 1868 steam-power was used for pumping, and in 1874 a second steam pump was added. It is double acting, with 12-in. bore and 36-in. stroke. In 1874, the wooden conduit from the spring to the pump-house was replaced by an 18-in. iron pipe. In 1872, the present reservoir, a circular iron tank 40 ft. in diameter and 8 ft. high was placed at a point 149 ft. above the spring.

The water is pumped directly into the mains, the tank being used only as a regulator of pressure.

There are 4 miles of cast-iron pipe of from 8 to 3-in. diameter, with 75 fire hydrants, 80 gates and 350 taps.

The population in 1880 was 5,000.

The works were controlled by the Bethlehem Water Company from 1845 to 1871, when they were purchased by the borough for $20,300. The cost of the works has been $30,000 to the present time. The bonded debt is $38,000, bearing 4½ per cent. interest. The expenses in 1881 were $5,000 and the receipts $3,600. The works are managed by the borough council through the water supply committee, of which C. M. Anstatt is Chairman. Charles Bodder is the Superintendent.

CCXC.—CHATEAUGAY.

Chateaugay, New York, in lat. 44° 56′ N., long. 74° 5′ W., is on nearly level ground, with a gradual slope to the north.

Settled in 1796, it was incorporated as a village in 1868.

Water-works were built in 1880 by a private company, after the plans of Carlisle E. Smith and John Hughes, taking the supply from a spring issuing from a ledge of rock 50 ft. high. The constant yield of the spring is about 1,500,000 gallons per day.

The water is collected in a basin 80 by 24 ft. and 4 ft. deep, built with stone masonry. It is half a mile from the village and 125 ft. above it.

The distribution is by wrought-iron and cement pipe of 6 and 4-in. diameter. Three miles of pipe are in use, with 14 fire hydrants, 5 gates and 100 taps.

The village pays $200 per year for the use of fire hydrants.

Service pipes are of galvanized iron.

The population in 1880 was 1,000. The daily consumption is about 20,000 gallons.

The capital stock of the company is $10,000. The works cost $9,500, and the receipts in 1881 were $800.

John Hughes is the Superintendent.

(TO BE CONTINUED.)

ACKNOWLEDGMENTS.—The receipt of statistics, as follows, is aknowledged with thanks: From John Hughes, Superintendent, statistics and water rates of the water-works of Chateauguay, N. Y. From Charles W. Knight, Engineer, twenty-ninth annual report of the Canajoharie (N. Y.) Water Company. From Timothy Woodruff, Superintendent, fourth annual report of the water-works of Bridgeton, N. J. From F. O. Weeks, Treasurer, statistics and reports of the water-works of Cedar Rapids, Ind. From Gilbert Murdoch, C. E., special report on water supply of St. John and Portland, N. B. From B. Johnson, Secretary and Treasurer, statistics and water rates of the water-works of Andes, N. Y. From G. M. Dorrance, Clerk Water Co., statistics and water rates of the water-works of Bristol, Pa. From Charles M. Anstett, Chairman Water Supply Committee, statistics and water rates of the water-works of Bethlehem, Pa. There are no water-works in Bloomfield, N. J., nor in Barrie, Canada.

THE PENNSYLVANIA STEEL COMPANY.

The following paper was read by L. S. Bent, superintendent, before the Harrisburg meeting of the American Institute of Mining Engineers:

The works of this company, the largest in Harrisburg, lie between the Pennsylvania and the Philadelphia & Reading railroads, on the Pennsylvania Canal, and are essentially devoted to the manufacture of Bessemer steel rails. Capital stock, $2,000,000; invested in business, $5,000,000; wages per month, $80,000; employs 2,000 men; capacity, 100,000 tons of rails per year, which is being increased to 130,000 tons.

The plant, as it now stands, comprises five Bessemer converters, two 7-ton and three 8-ton converters, two 15-ton open-hearth furnaces in operation, and two 30-ton open-hearth furnaces in course of construction, one blooming mill, one rail mill, seven steam hammers, two blast furnaces in operation, two blast furnaces in course of construction, foundry, pattern shop, machine shop, blacksmith shop and frog shop, and merchant mill in course of construction.

Bessemer No. 1 was built in 1865, with two 7-ton converters, 2 spiegel cupolas 3 ft. diameter, and 3 iron cupolas 6′ 6″ diameter, and has a capacity of 500 tons in 24 hours. The blowing engine is a horizontal condensing engine, with two steam cylinders, 40″x60″, and two blowing cylinders, 54″x60″. Pressure of blast, from 20 to 25 pounds.

Bessemer No. 2 was built in 1881. It has three 8-ton converters, served by two hydraulic ladle cranes, in two casting-pits, and six hydraulic cranes for setting and drawing molds, handling bottoms, etc. The hydraulic pressure is 300 lbs. per square inch. The blowing engine is compound horizontal, with a high-pressure cylinder, 25″x70″, and low pressure, 50″x70″, with separate air-pump condensers, and also a Bulkley condenser attached. Pressure of blast, 25 to 30 lbs. This engine was built in the Pennsylvania Steel Company's shops. There are four iron cupolas, 6′ 6″ diameter, and four spiegel cupolas, 3′ 0″ diameter, blown by two No. 7 Baker blowers, or two 3-cylinder blowing engines.

The capacity of this Bessemer has not yet been determined, as it has only been in operation two weeks. There are many points of improvement over the old Bessemer which cannot be described in this paper for want of time. All the castings, boilers, roofs, wrought-iron work and engines of this plant were made and erected by the Pennsylvania Steel Company.

The Blooming Train is three high; rolls 34″ in diameter, driven by a vertical condensing engine, 44″x54″ cylinder. The capacity of this mill has never been determined, but is easily 600 tons in 24 hours. The ingots are delivered hot to the blooming mill from the Bessemer, and charged into 4 Siemens heating furnaces, 6 ingots being a charge for each furnace. The ingots are 14″ square and make 4 rails each. The blooms are cut under a 4-ton steam hammer (Sellers), and are loaded by an hydraulic crane on buggies, which are pulled by a water engine to the rail mill.

The Rail Train is three high; rolls 23″ diameter, driven by a 40″x60″ engine, with Bulkley condenser attached. This train has rolled 1,916 rails in 24 hours. The saw-train is Gustin's patent. Two straightening presses and two drill dresses handle the rails as fast as rolled.

Open Hearth Furnaces, built in 1875, consisted of two 6-ton furnaces, which were enlarged later to 15-ton capacity. The new open-hearth furnaces in course of construction are each 30-ton. Each furnace has a casting-pit, and the two are served by five hydraulic cranes.

A 14-ton Steam Hammer is placed between the blooming mill and rail mill. Under it heavy shafts, cross-heads and piston rods are forged. When not in use for heavy work it hammers special steel into slabs and billets.

A 4-ton Hammer, adjoining the blooming mill, and a 1-ton hammer in the rail mill are used almost exclusively for slabs and billets.

The Foundry, 60′x225′, has two cupolas, 5′ 0″ diameter, two core ovens, and five 15-ton steam cranes. All ingot molds are made here, and all castings for repairs and new work. The capacity of the foundry is 40 tons of finished castings a day.

The Pattern Shop has two circular saws, one Daniel's planer, one hand planer, a bandsaw, and one lathe, and bench room for 14 men.

The Machine Shop is 75′ x 230′, and contains 13 lathes, from 96″ to 10″; five planers, which take from 8″ square to 20″ square; one 48″ boring lathe, one 84″ boring and turning machine, three 10′ radial drills, two drilling machines, two shapers, two slotting machines, two horizontal boring machines, two bolt cutters, one pipe cutter.

The Blacksmith Shop, 60′ x 75′, contains two 1,000-pound steam-hammers and 14 fires.

The Boiler Shop, 75′x127′, contains 3 drill-presses, 2 shears, 1 punching machine, bending-rolls, and 1 hydraulic riveting-machine. In this shop all steam-boilers, draft-stacks and iron-roofs are built.

The Frog Shop, 60′x400′, has a capacity of $30,000 to $40,000 per month in railroad frogs and switches, crossings and interlocking apparatus. It contains 14 planers, 6 drill-presses, 2 slotters, 3 lathes, 1 milling-machine, 1 shaper, 1 pin-machine, 1 steam-hammer, 1 combined punch and shear, 1 single punch, 1 steam-riveter, 1 hydraulic bending-machine, 10 fires, and 1 heating-furnace. A new frog shop is to be put up immediately, 80′x400′, with improved facilities.

Blast Furnaces.—No. 1, 14′x60′, is blown by a vertical condensing engine, 84″ blowing cylinder, 48″ stroke; it has 4 pipe-ovens, of Kent's pattern; the fuel used is anthracite coal and coke; the ores are native Pennsylvania, Virginia and New Jersey, and Spanish and African. The product 50 to 60 tons per day.

No. 2, 20′x76′, is blown by two vertical condensing engines, 84′x48″; 3 Whitwell stoves, 18′x60′; fuel and ores are the same as No. 1; product 840 tons per week. The product of both furnaces is used in the Bessemer.

No. 3 and No. 4 blast-furnaces are each 16′x65′. They are to be blown by vertical condensing-engine, 70′x48″, 2 blowing cylinders to each engine, with capacity for 22,000 cubic feet of air per minute. These engines are being built by the Pennsylvania Steel Company. Each furnace has 3 Whitwell stoves, 18′x60′, and will use the same fuel and ores as Nos. 1 and 2.

A Merchant Mill is in course of construction. The building, 100′x400′, will contain one 12-in. roll train and one 20-in. roll train; the first driven by a horizontal Hughes & Phillps engine, 22″x20″, the second by a horizontal Porter-Allen engine, 32″x48″.

The Heating Furnaces are Sweet's patent.

LACK OF CARE IN THE DETAILS OF IRON-WORK.

A paper on practical iron-work was recently read before the Civil and Mechanical Engineers' Society, England, in which it was remarked that sufficient care is not taken in the details of iron-work. The points of attachment will generally be found to be the weakest part; the compression members are considered as being able to bear four tons per square inch, while experiment and theory both seem to show that the strain which wrought-iron columns of the form in which struts are generally made can sustain more nearly approaches 2.7 tons per square inch of section, and that this value is in many cases too great. The loss from riveting in small girders is greater than is generally allowed for. The present form of upper and lower members in girders might be altered with advantage, vertical plates being used in the tension boom and gusset plates employed for attachment, allowing rivets in double shear. In bridges of small span ordinary lengths and sections of iron should be employed, but in large span bridges, when dead load predominates, greater refinement in designs may be used with advantage. All iron-work should be designed with regard to its erection, and in that which has to be sent long distances there should be no overhanging pieces of any length.

Continuous girders, though economical in first cost, are objectionable for use in road bridges, owing to vibrations, and it is doubtful whether their use is economical or safe in the end. Repeated shocks or vibrations producing fatigue will eventually cause the failure of all iron structures in which corrosion is not allowed to alter the conditions under which they were built, and as it may be concluded that the vibrations in continuous girders are more numerous with an equal number of shocks of the same intensity than in those of the non-continuous type, the life of the former will be shorter than that of the latter. Alterations in foundations which often change the conditions essential to the safe working of continuous girders are less liable to exert their influence on non-continuous girders. Close spacing of the cross girders of a bridge increases the number and extent of the vibrations and has an injurious effect on the girders themselves. The ignorant use of continuous girders may constantly be seen in the construction of warehouses and houses, where no care is taken to space the supports properly, where the quality of iron used is poor, where the margin of safety employed, as found from merchants' lists, is only from 2.7 to 3, and where failure of foundations is probable.

at the proper height, rollers put upon them and the machine hauled ahead by attaching a line from the hoisting drum to one of the piles, under the forward part of the carriage. One of the peculiar advantages of this machine, as will be seen, was that it required no skids or scaffolding for its transportation except the X braces and stays to hold the head of the pile steady while it was moving ahead. It would also cross the creek as easily as the marsh.

The locomotives in use on the Savannah, Florida & Western Railroad would concentrate a weight of slightly more than 18,000 lbs. on each pile, and it was deemed of great importance to have these reach a firm bearing. The specification, therefore, required that each pile should be driven until the average settlement per blow during the last three blows of the hammer, under the full fall of 25', should not exceed 1¼". This was adhered to throughout the work, with the exception of a few instances where quite a thick stratum of sand was encountered, into which the piles penetrated with great difficulty. Here it was thought they would possess considerable frictional stability.

The first pile driven gave no evidence that anything unusual was to be expected, receiving 30 blows and bringing up with the required settlement at a depth of 14 ft. The 30th pile was the first which gave indications that more or less difficulty was to be encountered. From this point, as will be seen by reference to the section, the piles increase in length, reaching the maximum at the 34th pile, which received 293 blows and attained a depth of 134' and 6" (134.5 ft.) This pile was composed of 9 sections, connected at the joints with round iron dowells, 1½" × 12", and was driven with great care, as there was considerable danger of one section jumping off of that below it. So soft was the mud that the first section of a pile would frequently descend the full length of the hammer guides without receiving a blow, and it was found necessary to put check chains on the hammers to prevent their moving out of the guides and being lost in the mud. After driving the second section of a pile the settlement would become comparatively uniform for each blow until bottom was reached, when the descent would be abruptly checked. So sudden and marked was this change in the rate of descent per blow that I felt no doubt in attributing it to the presence of rock similar to that found at varying depths in several borings I had made in the immediate vicinity, and which proved to be a very compact white marl, which in the mineralogical scale of hardness would correspond to 2½. Where this rock was exposed upon the bottom of the river with no overlying mud, it became necessary for the piles to be driven some distance into it to obtain the requisite steadiness. To accomplish this, they had to be shod with iron points, and even then were handled with difficulty. The rock was evidently much fissured, and cracks could be found with an ordinary probing rod. It would frequently happen that a pile after having been driven into the rock 3' or 4' would strike one of these fissures and spring completely out of the hammer guides. The piles for the wharf in the river were driven from a flat with a hammer of 2,240 lbs. The effect of this hammer with a fall of 25' on a pile resting on an unyielding bottom was well illustrated in one which was pulled up, because it was suspected that the shoe had failed to penetrate the rock. As will be remembered, the piles to be driven to a settlement of 1¼" for the last blow. In the case in question the pile had for several blows been settling slightly more than this, and when pulled up it was found that the end of the pile, which was about 9" in diameter, had been browed for a length of 3'. This would seem to be an argument in favor of a heavy hammer and low fall, and probably a heavier hammer would have proved efficacious under a low fall; but with the one in use, after trying both plans it was found that quite a heavy blow was required to make any impression whatsoever.

But to return to the long pile above-mentioned, it may not be amiss to remark here that it was driven half on one day and so left over night. When work was resumed the next morning careful observations were made to ascertain whether the friction upon its sides had increased at all during its static condition, as had been recorded in the case of other long piles, but no difference could be detected in the settlement per blow from that produced by the last blow of the previous day.

Were all the piles to be as deep as this it was evident the cost of the work would be proportionately large. The device, therefore, was tried of increasing the bearing surface of each pile by bolting to it a platform of timber 4' square. The platform was made by bolting on each side of the pile one piece of 6" × 12" timber 4' long and placing beneath them 3' plank 4' long at right angles to the pieces of timber. When the pile was driven this was forced down into the mud. The pile at *B* carries one of these platforms on its second section.

It had been observed that at about 30' below the surface a more or less compact stratum was encountered, but which was so thin that the piles would penetrate it and pass into soft material below. The object of the platform was only as an auxiliary support, so that it became necessary to ascertain the depth of the stratum at the position of each pile, and locate the platform so that it would not bring the pile to a stand until it had reached the stratum referred to, while at the same time it should oppose further settlement. This was determined with an ordinary gas pipe sounding rod, which could be forced down to the hard surface, but not through it, so compact was the material. The platform device worked well, but was only used in a few instances, as the stratum referred to increased in strength in the distance of the next two bents sufficiently to prevent the piles pushing through.

While the piles were of such great length it was thought best to stay them by some means. To accomplish this four bents were selected, two on each side of the long piles. These bents were composed of piles of single sections; on the outside of each of them single piles were driven, and the heads driven in under the bent caps and bolted. This gave two bents of two plumb and two batter piles, each on either side of the long pillar bent. Between these and over the intermediate bents a system of lateral bracing was run, which gave great steadiness to the whole.

Longitudinal X bracing was introduced wherever it would avail anything, but the greater part of the trestle was so low that it was not needed.

The whole of the work was done by day's labor, and cost $1.92 per running foot for everything below the cross-ties. The trestle has been in use freight trains since Oct. 1, 1881, and by passen trains since Jan. 1, 1882, and has given no ind tion of lack of stability.

THE HISTORY AND STATISTICS OF AME CAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.

Continued from page 131.

CCLXXXIV.—CEDAR RAPIDS.

Cedar Rapids, Iowa, in lat. 41° 58' N., long. 40' W., on Cedar River, is on slightly rolling grou rising gradually from the river for about hal mile to bluffs of from 25 to 50 ft. high, on wh many dwellings are built.

Settled in 1839, it was incorporated as a city 1856. Water-works were built by a pri pany in 187 ing the su a water-she is pumped machinery pound cond 26½ and 28-i engine with either as co are two dou eter and 30- and 24-in. st and the fire

Distributi from 16-in. t and 375 taps. for each hyd are used for

The population in 1880 was 10,104, and the dai consumption 550,000 gallons.

The capital stock of the company is $66,000, and there is a bonded debt of $65,000, bearing 8 per cent. interest. The expenses and receipts have been as follows:

	Maintenance.	Interest.	Receipts.
For year ending Mar. 31, 1881	$6,493.43	$6,162.73	$14,536.61
For year ending Mar 31, 1882	7,063.41	6,065.04	15,877.22

F. O. Weeks is Treasurer of the company, and C. J. Fox the Superintendent and Engineer.

CCLXXXV.—ANDES.

Andes, New York, in lat. 42° 12' N., long. 74° 42' W., is on Tremper's Kill, a small stream in a hilly country. Settled about 1817, it was incorporated as a village in 1861 and re-incorporated in 1879.

Water-works were built by a private company in 1876, under the superintendence of Thomas S. Miller.

The supply is taken from two springs which issue from opposite sides of a large rock, and yields about 140,000 gallons per day. The streams unite below the rock, and the water is led 12 ft. through a 6-in. pipe, over the wall of a reservoir 50 ft. square and 8 ft. deep, formed by a wall of stone laid in cement and blue clay, 4 ft. wide at bottom and 2 ft. at top. The reservoir is 160 ft. above the village, to which the water is conveyed through a 6-in. cast-iron pipe which is laid under the lower wall and across the bottom of the reservoir to the influent pipe.

Distribution is by 1½ miles of 6-in. and 8-in. cast-iron pipe, with 20 fire hydrants, 4 gates and 100 taps. The village exempts the company from taxation, in consideration of the use of water for fires. Lead service pipes are used.

The population in 1880 was 496 and the daily consumption 3,000 gallons. The capital stock of the company is $6,000. The works have cost to the present time $7,000 and the receipts have been $2,300. There is no debt. The expenses in 1880 were $25 and the receipts $380.

Barua Johnson is Secretary and Treasurer and Thomas S. Miller Superintendent.

CCLXXXVI.—LEROY.

Leroy, New York, in lat. 42° 57' N., long. 78° 6' W., is on Oatka Creek, which supplies a fine water-power.

In 1875 water-works for fire protection only were built by the village, taking the supply from the creek. Two water wheels in a mill drive 2 La France pumps which force the water through 2 miles of 6-in. cast-iron pipe, with 20 fire hydrants. No financial statements are given.

The population in 1880 was 1,468.

CCLXXXVII.—ST. JOHN AND PORTLAND.

St. John, New Brunswick, in lat. 45° 10' N., long. 66° 5' W., on the Bay of Fundy at the mouth of the St. John River is on a rocky peninsula with steep slopes. Settled about 1780, it was incorporated as a city in 1785. Portland, of later settlement, and under a separate municipal organization, adjoins St. John, and is supplied with water from that city. Water-works were built in 1836 by a private company, taking the supply from Lily Lake, a natural pond 80 ft. above the base of city levels and about 2 miles from the city. Leinster

The works are in charge of a board of commissioners of water-works and sewerage. Gilbert Murdoch, C. E., is the Superintendent.

CCLXXXVIII.—BRISTOL, PA.

Bristol, Pennsylvania, in lat. 40° 7' N., long. 74° 47' W., on the Delaware River, is on nearly level ground, 12 ft. above high water in the river. It was settled in 1684. Water-works were built in 1875 by a private company, after plans of William E. Morris, taking the supply from the Delaware River and pumping it by two Worthington duplex steam-pumps of 16-in. steam and 10-in. water cylinders into a stand-pipe 6 ft. in diameter and 140 ft. high.

Distribution is by 3½ miles of cast-iron pipe of from 12 to 4-in. diameter, with 280 taps. There are no fire hydrants. Service pipes are of lead.

The population in 1880 was 5,474. The daily consumption is 180,000 gallons, about two-thirds of which is used by the locomotives of the Pennsylvania Railroad.

The original cost of the works was $30,450, and $4,500 have since been spent in extensions. There is no debt.

The receipts and expenses since May, 1878, have been as follows:

	Receipts.	Expenses.
Year ending May, 1879	$5,414.67	$2,988.53
" " " 1880	5,650.13	2,290.85
" " " 1881	6,026.39	2,710.98

Anthony Swain is President of the company, Anthony K. Joyce the Superintendent, and G. M. Dorrance the Clerk.

CCLXXXIX.—BETHLEHEM.

Bethlehem, Pennsylvania, in lat. 40° 36′ 24″ N., long. 76° 56′ 8″ W., is on the northeast fork of the Lehigh River and Monoquacy Creek, on high and uneven land. It was settled in 1741 and incorporated as a borough in 1845.

Water-works were built in 1754, by Hans Christopher Christiansen, a millwright and a native of Denmark. These are believed to have been the first works for public water supply built in the United States. The water was taken from a spring issuing from magnesian limestone, near the banks of the Menogassi Creek, as it was then called.

The water was conducted 350 ft. through an under conduit into a cistern, whence it was pumped by a lignum vitæ pump of 5-in. bore, through bored hemlock logs, to a height of 70 ft., into a wooden tank in the village square. Trouble was experienced from the bursting of the pipes, and 1¼-in. pipes of sheet lead, soldered along the edges and bedded in a cement of pitch and brick dust and laid in a gutter of brick were tried without much success.

In 1762, Christiansen, aided by John Arbo and Marshall, constructed larger works. An 18-ft. undershot wheel drove three single-acting force pumps of iron of 4-in. bore and 18-in. stroke. The force main was of gum wood and the distributing pipes of pitch pine. The latter had to be renewed in 1769. In 1786 lead pipes were substituted for the gum wood force main and for most of the distributing pipes. The last pitch pine pipes were abandoned in 1791.

The reservoir was a wooden tower in the [illegible]

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from a ledge of rock 50 ft. high. The constant yield of the spring is about 1,500,000 gallons per day.

The water is collected in a basin 80 by 24 ft. and 4 ft. deep, built with stone masonry. It is half a mile from the village and 125 ft. above it.

The distribution is by wrought-iron and cement pipe of 6 and 4-in. diameter. Three miles of pipe are in use, with 14 fire hydrants, 5 gates and 100 taps.

The village pays $200 per year for the use of fire hydrants.

Service pipes are of galvanized iron.

The population in 1880 was 1,000. The daily consumption is about 20,000 gallons.

The capital stock of the company is $10,000. The works cost $9,500, and the receipts in 1881 were $800.

John Hughes is the Superintendent.

(TO BE CONTINUED.)

ACKNOWLEDGMENTS.—The receipt of statistics, as follows, is aknowledged with thanks: From John Hughes, Superintendent, statistics and water rates of the water-works of Chateauguay, N. Y. From Charles W. Knight, Engineer, twenty-ninth annual report of the Canajoharie (N. Y.) Water Company. From Timothy Woodruff, Superintendent, fourth annual report of the water-works of Bridgeton, N. J. From F. O. Weeks, Treasurer, statistics and reports of the water-works of Cedar Rapids, Ind. From Gilbert Murdoch, C. E., special report on water supply of St. John and Portland, N. B. From B. Johnson, Secretary and Treasurer, statistics and water rates of the water-works of Andes, N. Y. From G. M. Dorrance, Clerk Water Co., statistics and water rates of the water-works of Bristol, Pa. From Charles M. Anstett, Chairman Water Supply Committee, statistics and water rates of the water-works of Bethlehem, Pa. There are no water-works in Bloomfield, N. J., nor in Barrie, Canada.

THE PENNSYLVANIA STEEL COMPANY.

The following paper was read by L. S. Bent, superintendent, before the Harrisburg meeting of the American Institute of Mining Engineers:

The works of this company, the largest in Harrisburg, lie between the Pennsylvania and the Philadelphia & Reading railroads, on the Pennsylvania Canal, and are essentially devoted to the manufacture of Bessemer steel rails. Capital stock, $2,000,000; invested in business, $5,000,000; wages per month, $80,000; employs 2,000 men; capacity, 100,000 tons of rails per year, which is being increased to 130,000 tons.

The plant, as it now stands, comprises five Bessemer converters, two 7-ton and three 8-ton converters, two 15-ton open-hearth furnaces in operation, and two 30-ton open-hearth furnaces in course of construction, one blooming mill, one rail mill, seven steam hammers, two blast furnaces in operation, two blast furnaces in course of construction, foundry, pattern shop, machine shop, blacksmith shop and frog shop, and merchant mill

[redacted]

loaded by an hydraulic crane on buggies, which are pulled by a water engine to the rail mill.

The Rail Train is three high; rolls 23″ diameter, driven by a 40″x60″ engine, with Bulkley condenser attached. This train has rolled 1,916 rails in 24 hours. The saw-train is Gustin's patent. Two straightening presses and two drill dresses handle the rails as fast as rolled.

Open Hearth Furnaces, built in 1875, consisted of two 6-ton furnaces, which were enlarged later to 15-ton capacity. The new open-hearth furnaces in course of construction are each 30-ton. Each furnace has a casting-pit, and the two are served by five hydraulic cranes.

A 14-ton Steam Hammer is placed between the blooming mill and rail mill. Under it heavy shafts, cross-heads and piston rods are forged. When not in use for heavy work it hammers special steel into slabs and billets.

A 4-ton Hammer, adjoining the blooming mill, and a 1-ton hammer in the rail mill are used almost exclusively for slabs and billets.

The Foundry, 60′x225′, has two cupolas, 5′ 0″ diameter, two core ovens, and five 15-ton steam cranes. All ingot molds are made here, and all castings for repairs and new work. The capacity of the foundry is 40 tons of finished castings a day.

The Pattern Shop has two circular saws, one Daniel's planer, one hand planer, a bandsaw, and one lathe, and bench room for 14 men.

The Machine Shop is 75′ x 230′, and contains 13 lathes, from 96″ to 10″; five planers, which take from 8′ square to 20″ square; one 48″ boring lathe, one 84″ boring and turning machine, three 10′ radial drills, two drilling machines, two shapers, two slotting machines, two horizontal boring machines, two bolt cutters, one pipe cutter.

The Blacksmith Shop, 60′ x 75′, contains two 1,000-pound steam-hammers and 14 fires.

The Boiler Shop, 75′x127′, contains 3 drill-presses, 2 shears, 1 punching machine, bending-rolls, and 1 hydraulic riveting-machine. In this shop all steam-boilers, draft-stacks and iron-roofs are built.

The Frog Shop, 60′x400′, has a capacity of $30,000 to $40,000 per month in railroad frogs and switches, crossings and interlocking apparatus. It contains 14 planers, 6 drill-presses, 2 slotters, 2 lathes, 1 milling-machine, 1 shaper, 1 pin-machine, 1 steam-hammer, 1 combined punch and shear, 1 single punch, 1 steam-riveter, 1 hydraulic bending-machine, 10 fires, and 1 heating-furnace. A new frog shop is to be put up immediately, 80′x400′, with improved facilities.

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It had been observed that at about 30' below the surface a more or less compact stratum was encountered, but which was so thin that the piles would penetrate it and pass into soft material below. The object of the platform was only as an auxiliary support, so that it became necessary to ascertain the depth of the stratum at the position of each pile, and locate the platform so that it would not bring the pile to a stand until it had reached the stratum referred to, while at the same time it should oppose further settlement. This was determined with an ordinary gas pipe sounding rod, which could be forced down to the hard surface, but not through it, so compact was the material. The platform device worked well, but was only used in a few instances, as the stratum referred to increased in strength in the distance of the next two bents sufficiently to prevent the piles pushing through.

While the piles were of such great length it was thought best to stay them by some means. To accomplish this four bents were selected, two on each side of the long piles. These bents were composed of piles of single sections; on the outside of each of them single piles were driven, and the heads driven in under the bent caps and bolted. This gave two bents of two plumb and two batter piles, each on either side of the long pillar bent. Between these and over the intermediate bents a system of lateral bracing was run, which gave great steadiness to the whole.

Longitudinal X bracing was introduced wherever it would avail anything, but the greater part of the trestle was so low that it was not needed.

The whole of the work was done by day's labor, and cost $1.92 per running foot for everything below the cross-ties. The trestle has been in use by freight trains since Oct. 1, 1881, and by passenger trains since Jan. 1, 1882, and has given no indication of lack of stability.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.

Continued from page 131.

CCLXXXIV.—CEDAR RAPIDS.

Cedar Rapids, Iowa, in lat. 41° 58' N., long. 91° 40' W., on Cedar River, is on slightly rolling ground rising gradually from the river for about half a mile to bluffs of from 25 to 50 ft. high, on which many dwellings are built.

Settled in 1839, it was incorporated as a city in 1856. Water-works were built by a private company in 1875, after the plans of J. T. Cushing, taking the supply from Cedar River, which has a water-shed of about 700 square miles. The water is pumped directly into the mains by steam machinery built by McGowan. There is one compound condensing engine with steam cylinders of 26½ and 28-in. diameter and 30-in. stroke, and one engine with 16-in cylinder of 24-in. stroke, operated either as condensing or non condensing. There are two double-acting piston pumps of 13-in. diameter and 30-in. stroke, and two of 10-in. diameter and 24-in. stroke. The ordinary pressure is 60 lbs. and the fire pressure 800 to 100 lbs.

Distribution is by 8 miles of cast-iron pipe of from 16-in. to 4-in. diameter, with 76 fire hydrants and 375 taps. The city pays $75 to $100 per year for each hydrant. Both lead and wrought iron are used for service pipe.

The population in 1880 was 10,104, and the daily consumption 550,000 gallons.

The capital stock of the company is $66,000, and there is a bonded debt of $65,000, bearing 8 per cent. interest. The expenses and receipts have been as follows:

	Maintenance.	Interest.	Receipts.
For year ending Mar. 31, 1881	$6,493.43	$6,162.73	$14,536.61
For year ending Mar 31, 1882	7,063.41	6,065.04	15,877.22

F. O. Weeks is Treasurer of the company, and C. J. Fox the Superintendent and Engineer.

CCLXXXV.—ANDES.

Andes, New York, in lat. 42° 12' N., long. 74° 42' W., is on Tremper's Kill, a small stream in a hilly country. Settled about 1817, it was incorporated as a village in 1861 and re-incorporated in 1879.

Water-works were built by a private company in 1876, under the superintendence of Thomas S. Miller.

The supply is taken from two springs which issue from opposite sides of a large rock, and yields about 140,000 gallons per day. The streams unite below the rock, and the water is led 12 ft. through a 6-in. pipe, over the wall of a reservoir 50 ft. square and 8 ft. deep, formed by a wall of stone laid in cement and blue clay, 4 ft. wide at bottom and 2 ft. at top. The reservoir is 160 ft. above the village, to which the water is conveyed through a 6-in. cast-iron pipe which is laid under the lower wall and across the bottom of the reservoir to the influent pipe.

Distribution is by 1½ miles of 6-in. and 8-in. cast-iron pipe, with 20 fire hydrants, 4 gates and 100 taps. The village exempts the company from taxation, in consideration of the use of water for fires. Lead service pipes are used.

The population in 1880 was 496 and the daily consumption 3,000 gallons. The capital stock of the company is $6,000. The works have cost to the present time $7,000 and the receipts have been $2,300. There is no debt. The expenses in 1880 were $25 and the receipts $380.

Barna Johnson is Secretary and Treasurer and Thomas S. Miller Superintendent.

CCLXXXVI.—LEROY.

Leroy, New York, in lat. 42° 57' N., long. 78° 6' W., is on Oatka Creek, which supplies a fine water-power.

In 1875 water-works for fire protection only were built by the village, taking the supply from the creek. Two water wheels in a mill drive 2 La France pumps which force the water through 2 miles of 6-in. cast-iron pipe, with 20 fire hydrants. No financial statements are given.

The population in 1880 was 1,468.

CCLXXXVII.—ST. JOHN AND PORTLAND.

St. John, New Brunswick, in lat. 45° 10' N., long. 66° 5' W., on the Bay of Fundy at the mouth of the St. John River is on a rocky peninsula with steep slopes. Settled about 1780, it was incorporated as a city in 1785. Portland, of later settlement, and under a separate municipal organization, adjoins St. John, and is supplied with water from that city. Water-works were built in 1836 by a private company, taking the supply from Lily Lake, a natural pond 80 ft. above the base of city levels and about 2 miles from the city. Leinster reservoir, 143 ft. above base of levels, built of masonry and holding 300,000 gallons, was filled by pumping with a steam pump three or four times a week. The water was allowed to enter the distributing pipes only from 6 to 8 o'clock in the morning of each day, during which time consumers had to draw their daily supply.

In 1849 the company built additional works, after plans of George H. Bailey, C. E., taking the supply from Little River, about 4 miles from the city, where an impounding reservoir of 37½ acres area was constructed at 160 ft. above the city datum, and the water conveyed to the city in a 12-in. cast-iron pipe, and the pumping works were abandoned. In 1851, Lake Latimer, of 200 acres area, at 300 ft. above city datum, was made available by damming its natural outlet into Mispeck River, and connecting it by a conduit with Little River. In 1855 the works were purchased by the city. In 1857 another supply main was laid, of 24-in. diameter, and in 1873 another of 24-in. diameter. The regular daily supply is now taken from the Little River reservoir, the Leinster reservoir being used for fire purposes only.

Distribution is by cast-iron pipe of from 15-in. to 3-in. diameter. There 32.15 miles in use, with 276 fire hydrants, 49 free hydrants for the use of the poor, 671 gates, 3,733 taps, and 121 meters. Lead pipe is used for all services of 1 in. or less diameter.

The total cost of the works to Jan. 1, 1882, was $987,471.50. This includes interest and maintenance.

The cost of maintenance and repairs in 1881 was $12,844. The revenue from "agreement customers" was $9,279.33 and the assessment on property for water purposes was $68,099.90. The population of the two cities is about 32,000. St. John was almost totally destroyed by fire June 20, 1877. On Nov. 23, 1880, the supply of water was suddenly cut off for some hours by the formation of anchor ice or *frasil* in the outlet chamer at the reservoir.

The works are in charge of a board of commissioners of water-works and sewerage. Gilbert Murdoch, C. E., is the Superintendent.

CCLXXXVIII.—BRISTOL, PA.

Bristol, Pennsylvania, in lat. 40° 7' N., long. 74° 47' W., on the Delaware River, is on nearly level ground, 12 ft. above high water in the river. It was settled in 1684. Water-works were built in 1875 by a private company, after plans of William E. Morris, taking the supply from the Delaware River and pumping it by two Worthington duplex steam-pumps of 16-in. steam and 10-in. water cylinders into a stand-pipe 6 ft. in diameter and 140 ft. high.

Distribution is by 3½ miles of cast-iron pipe of from 12 to 4-in. diameter, with 280 taps. There are no fire hydrants. Service pipes are of lead.

The population in 1880 was 5,474. The daily consumption is 130,000 gallons, about two-thirds of which is used by the locomotives of the Pennsylvania Railroad.

The original cost of the works was $39,450, and $4,500 have since been spent in extensions. There is no debt.

The receipts and expenses since May, 1878, have been as follows:

	Receipts.	Expenses.
Year ending May, 1879	$5,414.67	$2,068.58
" " " 1880	5,650.13	2,290.65
" " " 1881	6,026.30	2,710.98

Anthony Swain is President of the company, Anthony K. Joyce the Superintendent, and G. M. Dorrance the Clerk.

CCLXXXIX.—BETHLEHEM.

Bethlehem, Pennsylvania, in lat. 40° 36′ 24″ N., long. 76° 56′ 8″ W., is on the northeast fork of the Lehigh River and Monoquacy Creek, on high and uneven land. It was settled in 1741 and incorporated as a borough in 1845.

Water-works were built in 1754, by Hans Christopher Christiansen, a millwright and a native of Denmark. These are believed to have been the first works for public water supply built in the United States. The water was taken from a spring issuing from magnesian limestone, near the banks of the Menogassi Creek, as it was then called.

The water was conducted 350 ft. through an under conduit into a cistern, whence it was pumped by a lignum vitæ pump of 5-in. bore, through bored hemlock logs, to a height of 70 ft., into a wooden tank in the village square. Trouble was experienced from the bursting of the pipes, and 1½-in. pipes of sheet lead, soldered along the edges and bedded in a cement of pitch and brick dust and laid in a gutter of brick were tried without much success.

In 1762, Christiansen, aided by John Arbo and Marshall, constructed larger works. An 18-ft. undershot wheel drove three single-acting force pumps of iron of 4-in. bore and 18-in. stroke. The force main was of gum wood and the distributing pipes of pitch pine. The latter had to be renewed in 1769. In 1786 lead pipes were substituted for the gum wood force main and for most of the distributing pipes. The last pitch pine pipes were abandoned in 1791.

The reservoir was a wooden tower in the "little square." This was removed in 1803 and a stone tower built on Market street, about 15 ft. high, in which was a tank at an elevation of 112 ft. above the spring. A reservoir 70 ft. long, 10 ft. wide and 7 ft. deep was built in 1817. In 1832 another reservoir was constructed on higher ground and the water tower abandoned. In 1832 the triple pumps were replaced by one double-acting pump. In 1868 steam-power was used for pumping, and in 1874 a second steam pump was added. It is double acting, with 12-in. bore and 36-in. stroke. In 1874, the wooden conduit from the spring to the pump-house was replaced by an 18-in. iron pipe. In 1872, the present reservoir, a circular iron tank 40 ft. in diameter and 8 ft. high was placed at a point 149 ft. above the spring.

The water is pumped directly into the mains, the tank being used only as a regulator of pressure.

There are 4 miles of cast-iron pipe of from 8 to 3-in. diameter, with 75 fire hydrants, 80 gates and 350 taps.

The population in 1880 was 5,000.

The works were controlled by the Bethlehem Water Company from 1845 to 1871, when they were purchased by the borough for $20,300. The cost of the works has been $30,000 to the present time. The bonded debt is $38,000, bearing 5½ per cent. interest. The expenses in 1881 were $5,000 and the receipts $3,600. The works are managed by the borough council through the water supply committee, of which C. M. Anstatt is Chairman. Charles Bodder is the Superintendent.

CCXC.—CHATEAUGAY.

Chateaugay, New York, in lat. 44° 56′ N., long. 74° 5′ W., is on nearly level ground, with a gradual slope to the north.

Settled in 1796, it was incorporated as a village in 1868.

Water-works were built in 1880 by a private company, after the plans of Carlisle E. Smith and John Hughes, taking the supply from a spring issuing from a ledge of rock 50 ft. high. The constant yield of the spring is about 1,500,000 gallons per day.

The water is collected in a basin 80 by 24 ft. and 4 ft. deep, built with stone masonry. It is half a mile from the village and 125 ft. above it.

The distribution is by wrought-iron and cement pipe of 6 and 4-in. diameter. Three miles of pipe are in use, with 14 fire hydrants, 5 gates and 100 taps.

The village pays $200 per year for the use of fire hydrants.

Service pipes are of galvanized iron.

The population in 1880 was 1,000. The daily consumption is about 20,000 gallons.

The capital stock of the company is $10,000. The works cost $9,500, and the receipts in 1881 were $800.

John Hughes is the Superintendent.

(TO BE CONTINUED.)

ACKNOWLEDGMENTS.—The receipt of statistics, as follows, is aknowledged with thanks: From John Hughes, Superintendent, statistics and water rates of the water-works of Chateauguay, N. Y. From Charles W. Knight, Engineer, twenty-ninth annual report of the Canajoharie (N. Y.) Water Company. From Timothy Woodruff, Superintendent, fourth annual report of the water-works of Bridgeton, N. J. From F. O. Weeks, Treasurer, statistics and reports of the water-works of Cedar Rapids, Ind. From Gilbert Murdoch, C. E., special report on water supply of St. John and Portland, N. B. From B. Johnson, Secretary and Treasurer, statistics and water rates of the water-works of Andes, N. Y. From G. M. Dorrance, Clerk Water Co., statistics and water rates of the water-works of Bristol, Pa. From Charles M. Anstett, Chairman Water Supply Committee, statistics and water rates of the water-works of Bethlehem, Pa. There are no water-works in Bloomfield, N. J., nor in Barrie, Canada.

THE PENNSYLVANIA STEEL COMPANY.

The following paper was read by L. S. Bent, superintendent, before the Harrisburg meeting of the American Institute of Mining Engineers:

The works of this company, the largest in Harrisburg, lie between the Pennsylvania and the Philadelphia & Reading railroads, on the Pennsylvania Canal, and are essentially devoted to the manufacture of Bessemer steel rails. Capital stock, $2,000,000; invested in business, $5,000,000; wages per month, $80,000; employs 2,000 men; capacity, 100,000 tons of rails per year, which is being increased to 130,000 tons.

The plant, as it now stands, comprises five Bessemer converters, two 7-ton and three 8-ton converters, two 15-ton open-hearth furnaces in operation, and two 30-ton open-hearth furnaces in course of construction, one blooming mill, one rail mill, seven steam hammers, two blast furnaces in operation, two blast furnaces in course of construction, foundry, pattern shop, machine shop, blacksmith shop and frog shop, and merchant mill in course of construction.

Bessemer No. 1 was built in 1865, with two 7-ton converters, 2 spiegel cupolas 3 ft. diameter, and 3 iron cupolas 6′ 6″ diameter, and has a capacity of 500 tons in 24 hours. The blowing engine is a horizoutal condensing engine, with two steam cylinders, 40″x60″, and two blowing cylinders, 54″x60″. Pressure of blast, from 20 to 25 pounds.

Bessemer No. 2 was built in 1881. It has three 8-ton converters, served by two hydraulic ladle cranes, in two casting-pits, and six hydraulic cranes for setting and drawing molds, handling bottoms, etc. The hydraulic pressure is 300 lbs. per square inch. The blowing engine is compound horizontal, with a high-pressure cylinder, 25″x70″, and low pressure, 50″x70″, with separate air-pump condensers, and also a Bulkley condenser attached. Pressure of blast, 25 to 30 lbs. This engine was built in the Pennsylvania Steel Company's shops. There are four iron cupolas, 6′ 6″ diameter, and four spiegel cupolas, 3′ 0″ diameter, blown by two No. 7 Baker blowers, or two 3-cylinder blowing engines.

The capacity of this Bessemer has not yet been determined, as it has only been in operation two weeks. There are many points of improvement over the old Bessemer which cannot be described in this paper for want of time. All the castings, boilers, roofs, wrought-iron work and engines of this plant were made and erected by the Pennsylvania Steel Company.

The Blooming Train is three high; rolls 34″ in diameter, driven by a vertical condensing engine, 44″x54″ cylinder. The capacity of this mill has never been determined, but is easily 600 tons in 24 hours. The ingots are delivered hot to the blooming mill from the Bessemer, and charged into 4 Siemens heating furnaces, 6 ingots being a charge for each furnace. The ingots are 14″ square and make 4 rails each. The blooms are cut under a 4-ton steam hammer (Sellers), and are loaded by an hydraulic crane on buggies, which are pulled by a water engine to the rail mill.

The Rail Train is three high; rolls 23″ diameter, driven by a 40″x60″ engine, with Bulkley condenser attached. This train has rolled 1,916 rails in 24 hours. The saw-train is Gustin's patent. Two straightening presses and two drill dresses handle the rails as fast as rolled.

Open Hearth Furnaces, built in 1875, consisted of two 6-ton furnaces, which were enlarged later to 15-ton capacity. The new open-hearth furnaces in course of construction are each 30-ton. Each furnace has a casting-pit, and the two are served by five hydraulic cranes.

A 14-ton Steam Hammer is placed between the blooming mill and rail mill. Under it heavy shafts, cross-heads and piston rods are forged. When not in use for heavy work it hammers special steel into slabs and billets.

A 4-ton Hammer, adjoining the blooming mill, and a 1-ton hammer in the rail mill are used almost exclusively for slabs and billets.

The Foundry, 60′x225′, has two cupolas, 5′ 0″ diameter, two core ovens, and five 15-ton steam cranes. All ingot molds are made here, and all castings for repairs and new work. The capacity of the foundry is 40 tons of finished castings a day.

The Pattern Shop has two circular saws, one Daniel's planer, one hand planer, a bandsaw, and one lathe, and bench room for 14 men.

The Machine Shop is 75′ x 230′, and contains 13 lathes, from 96″ to 10″; five planers, which take from 8′ square to 20′ square; one 48″ boring lathe, one 84″ boring and turning machine, three 10′ radial drills, two drilling machines, two shapers, two slotting machines, two horizontal boring machines, two bolt cutters, one pipe cutter.

The Blacksmith Shop, 60′ x 75′, contains two 1,000-pound steam-hammers and 14 fires.

The Boiler Shop, 75′x127′, contains 3 drill-presses, 2 shears, 1 punching machine, bending-rolls, and 1 hydraulic riveting-machine. In this shop all steam-boilers, draft-stacks and iron-roofs are built.

The Frog Shop, 60′x400′, has a capacity of $30,000 to $40,000 per month in railroad frogs and switches, crossings and interlocking apparatus. It contains 14 planers, 6 drill-presses, 2 slotters, 2 lathes, 1 milling-machine, 1 shaper, 1 pin-machine, 1 steam-hammer, 1 combined punch and shear, 1 single punch, 1 steam-riveter, 1 hydraulic bending-machine, 10 fires, and 1 heating-furnace. A new frog shop is to be put up immediately, 80′x400′, with improved facilities.

Blast Furnaces.—No. 1, 14′x60′, is blown by a vertical condensing engine, 84″ blowing cylinder, 48″ stroke; it has 4 pipe-ovens, of Kent's pattern; the fuel used is anthracite coal and coke; the ores are native Pennsylvania, Virginia and New Jersey, and Spanish and African. The product 50 to 60 tons per day.

No. 2, 20′x76′, is blown by two vertical condensing engines, 84′x18″; 3 Whitwell stoves, 18′x60′; fuel and ores are the same as No. 1; product 840 tons per week. The product of both furnaces is used in the Bessemer.

No. 3 and No. 4 blast-furnaces are each 16′x65′. They are to be blown by vertical condensing-engine, 70″x48″, 2 blowing cylinders to each engine, with capacity for 22,000 cubic feet of air per minute. These engines are being built by the Pennsylvania Steel Company. Each furnace has 3 Whitwell stoves, 18′x60′, and will use the same fuel and ores as Nos. 1 and 2.

A Merchant Mill is in course of construction. The building, 100′x400′, will contain one 12-in. roll train and one 20-in. roll train; the first driven by a horizontal Hughes & Phillps engine, 22″x20″, the second by a horizontal Porter-Allen engine, 32″x48″.

The Heating Furnaces are Sweet's patent.

LACK OF CARE IN THE DETAILS OF IRON-WORK.

A paper on practical iron-work was recently read before the Civil and Mechanical Engineers' Society, England, in which it was remarked that sufficient care is not taken in the details of iron-work. The points of attachment will generally be found to be the weakest part; the compression members are considered as being able to bear four tons per square inch, while experiment and theory both seem to show that the strain which wrought-iron columns of the form in which struts are generally made can sustain more nearly approaches 2.7 tons per square inch of section, and that this value is in many cases too great. The loss from riveting in small girders is greater than is generally allowed for. The present form of upper and lower members in girders might be altered with advantage, vertical plates being used in the tension boom and gusset plates employed for attachment, allowing rivets in double shear. In bridges of small span ordinary lengths and sections of iron should be employed, but in large span bridges, when dead load predominates, greater refinement in designs may be used with advantage. All iron-work should be designed with regard to its erection, and in that which has to be sent long distances there should be no overhanging pieces of any length.

Continuous girders, though economical in first cost, are objectionable for use in road bridges, owing to vibrations, and it is doubtful whether their use is economical or safe in the end. Repeated shocks or vibrations producing fatigue will eventually cause the failure of all iron structures in which corrosion is not allowed to alter the conditions under which they were built, and as it may be concluded that the vibrations in continuous girders are more numerous with an equal number of shocks of the same intensity than in those of the non-continuous type, the life of the former will be shorter than that of the latter. Alterations in foundations which often change the conditions essential to the safe working of continuous girders are less liable to exert their influence on non-continuous girders. Close spacing of the cross girders of a bridge increases the number and extent of the vibrations and has an injurious effect on the girders themselves. The ignorant use of continuous girders may constantly be seen in the construction of warehouses and houses, where no care is taken to space the supports properly, where the quality of iron used is poor, where the margin of safety employed, as found from merchants' lists, is only from 2.7 to 3, and where failure of foundations is probable.

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JULIUS W. ADAMS, *Past President A. S. C. E.*, EDITOR.
S. D. V. BURR. .....ASSOCIATE EDITOR.

SATURDAY, APRIL 29, 1882.

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Articles for Publication in the current number should be received at the office of publication not later than Thursday morning, and advertisements not later than Friday noon.

Correspondence upon subjects which naturally belongs to the province of this journal is solicited.

CONTENTS.

	Page.
Trestle over McCoy's Creek, Fla. (*Illustrated*)	133
The History and Statistics of American Waterworks	134
The Pennsylvania Steel Company	135
Lack of Care in the Details of Iron Work	135
EDITORIAL DEPARTMENT:	
Pavements of Cities	136
Radius of Gyration	137
CORRESPONDENCE:	
What Is It?	137
Personal	137
ENGINEERS' SOCIETIES:	
American Society of Civil Engineers	138
ENGINEERS' SOCIETIES:	
Liverpool Engineering Society	138
Recent Inventions	138
Improvement of the Mississippi	139
Usefulness of Engineers' Societies	139
Salt Without Savor	139
Nonpareil Plumb bob (*Illustrated*)	140
Connecticut Legislation	140
Brickwork Under Pressure	140
Florida Notes	140
Contracts for Lighting this City with Gas and Electricity	140

NOTICES OF MEETINGS.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—ANNUAL CONVENTION, WASHINGTON, D. C., MAY 16, 1882.—The Annual Convention of the Society for the year 1882 will be held at Washington, beginning Tuesday, May 16, 1882. Sessions for professional discussion and one for the transaction of business will be held. At one of the sessions, the annual address will be delivered by the President, Mr. Ashbel Welch.

The general arrangements for the Convention are now in preparation, and will be announced. Details of the programme are in charge of the local committee at Washington, the chairman of which is Col. Thos. Lincoln Casey, Corps of Engineers, U. S. A., Director Am. Soc. C. E.

The families of members are invited to accompany them.

PAVEMENTS OF CITIES.

The American Asphalt Pavement Co., under the Desmedt patent, have laid a large extent of pavement in the city of Washington, D. C., and referring to it as meeting all the objections heretofore existing against such pavement, state it as the opinion of engineers that, "Washington is the best paved and cleanest city in the world." To accept this at its true value, the circumstances of the case must be taken into consideration. This we think is very much lost sight of in claiming for the American asphalt that its superiority over the foreign asphalt is such as to justify the opinion that this will be the "coming pavement." Although the opinions of engineers of prominence and city officials are given somewhat in detail, in which the statement is made, "that the pavement as laid in Washington is suitable for *heavy traffic* as well as light." In the opinion given by Gen. M. C. Meigs, he does qualify this so far as to say that, "it will be necessary to make *frequent renewals* of the wearing surface, but this is cheap." Yet he recommends it most unqualifiedly for heavy traffic. We do not doubt that for the wide avenues and streets of Washington, with comparatively light traffic, and the convenience offered for making repairs without interference with the traffic, this form of pavement will prove a great luxury, always supposing, as in Paris, that the surface is swept clean daily, and before the travel commences early in the morning, and at the same time slight repairs are made. In other words, the mud or dust not being allowed to collect and aid in cutting the pavement into ruts, and the *pavement never being allowed to get out of repair*. These two requirements are essential to its preservation and economical maintenance, and if faithfully carried out the greatest efficiency may be anticipated; but if neglected, as it is likely to be under the ordinary police of our American cities, nothing can be looked for but an intolerable nuisance.

There is another point which will ever prevent (unless a radical change is effected in the rights of property owners to occupy the spaces under the streets in the substructures) any pavement remaining in decent condition for any length of time, and that is the tearing up and loosely replacing in a slipshod manner the surface in order to lay pipes for gas, water or other purposes.

About the year 1871 the Russ pavement, which had been laid in Broadway at great expense under a patent, and which consisted of heavy blocks of granite laid flatwise on a concrete bottom, proved so dangerous for horses that it was taken up and the present pavement of granite blocks set on edge, known as the Guidet pavement, was substituted. This is an admirable pavement, and would have remained intact with all the heavy traffic of that street for 20 years to come. But after a short time some pipe was needed under the street and the pavement was taken up and, when replaced, was left a little higher than the remainder with a view to proper settlement, as was supposed. The result was the irregular settlement and cutting into ruts, so that the line of pipe a year after it was laid could be traced with the eye as readily as if the trench were still open. This was followed with other lines of pipes for various purposes and conducted in the same manner, and the result is that there are deep holes and prominences and ruts, which will render a general repairing necessary in a short time.

Some months since, Fulton street from Broadway to the Ferry was laid with the same kind of granite blocks, upon a thick bed of concrete, making such a pavement as the grinding action of the heavy carts and wagons frequenting that street called for. This street of cobble-stone pavement had for a long time been in a dangerous condition, and the completion of the granite block pavement was a boon to horse and man.

A few weeks since the Electric Light Company cut a trench on both sides of the street to within a block of the Ferry, and filling it over their pipes in the usual manner, the integrity of the pavement from curb to curb is destroyed, and the mischief is begun which will result as in Broadway. No police regulations, if any such existed, could be effectual to prevent the destruction before its time of any pavement with concrete foundation (as all pavements should have) which was constantly being ripped up in small patches, and replaced by the kind of workmen to whom such operations are confided.

Before we can have a permanently good pavement in any of our populous cities, the system of breaking it up at intervals must be abandoned. The right to build street vaults must be restricted, and all pipes must be laid under the sidewalks. Where large sewers exist, connections must be made by tunneling. The same difficulty now existing with us had been experienced in Paris, which led to the enlargement of the sewers and the laying of the pipes for water and gas on brackets at the sides and top, thus avoiding the necessity of breaking up the street pavement lengthwise of the street; and the system still exists to a large extent, forming what are called sub-ways, and it has been recommended elsewhere; but the difficulty experienced in preserving the gas-pipes free of leaks has proved so great, and the accidents thereby entailed so serious, that the method no longer finds favor.

The precise value of the American asphalt for pavements cannot be better shown than by an extract from Lieut. Green's, U. S. E., report on the Washington pavements. Although we must object to the length of time, *from 15 to 20 years*, which he gives for the lifetime of the asphalt, we would remark that the first cost of this pavement and that of granite blocks differs but little:

"The asphalt pavement is laid as follows: A foundation of 6 in. of hydraulic cement concrete and a wearing surface of bituminous mastic, laid in two coats, respectively ½ in. and 2 in. thick when compressed. The mastic is composed of the following parts by weight:

Asphaltic cement (refined Midland asphalt) 100 parts:

Petroleum oil, 20 parts	15 to 18
Limestone powder	15 to 17
Sand	70 to 65
	100 100

The specification last year called for 18 to 20 per cent. of asphaltum cement, but experience showed that this proportion made the pavement too soft in summer, and the proportion actually used was between 16 and 17 per cent. The theory of this pavement is a solid base of concrete masonry, practically imperishable, and a comparatively thin and smooth wearing surface, which can be replaced when it is worn out—say every *fifteen or twenty years*. The concrete base is easily made, and satisfies all the conditions. In making the wearing surface, there are some practical difficulties which require constant attention and skilled, experienced labor. The pavement is subjected to a temperature of 150° in summer and — 10° in winter, a range of 160° Fahr., at all of which temperatures it is required to present a uniform surface. The danger in practice is that in extreme cold the surface will crack and become friable, and in extreme heat it will become so soft that it will roll or creep under the traffic, and present a wavy surface very uncomfortable to travel on. Refined asphalt is very brittle at a temperature of 60° Fahr., or less; when tempered with the heavy oil resulting from petroleum distillation it becomes ductile and tough, but if the heavy oil is added in excess—say above 20 per cent.—the mixture will fuse or run at a temperature of 150°, or even less. The problem is, therefore, to mix these two hydro-carbons in such proportions that the mixture shall neither be brittle nor liquid under the extremes of cold and heat actually experienced on the streets. Up to the present time the proportion of oil has been kept at about 20 to 100, or 16⅔ per cent. None of the pavements laid since 1878 have cracked under the cold (minimum—5° Fahr.) of the two winters since that date. A few of them have, in two or three small places, crept into waves under the heat of summer, as, in spite of all precautions, mistakes will sometimes occur in the preparation or handling of the material.

The mixture of asphalt (*i. e.*, mineral bitumen) and petroleum oil is the cement which binds together the particles of sand, which form two-thirds of the wearing surface and constitute its real resisting material. This cement must be less than enough to fill the voids in the sand, and only enough to bind them together when perfectly compassed. In order to reduce the voids as much as possible, ground limestone powder is added to the sand in the proportion of about 1 to 4. The powder is of such degree of fineness that it will all pass a 26 screen, and 75 per cent. of it will pass a 40 screen. The cement, as previously stated, is added in the proportion of about 15 to 85 of sand and limestone powder combined. The oldest pavement of this class is the one laid by the paving commission of 1876 on Pennsylvania avenue between Sixth and Fifteenth streets. This has now been on the street between three and four years, and the repairs (made at the expense of the contractors) are understood to have cost $2,142.50, or at the rate of $714.16 per annum, the number of yards being 53,198.80. The annual expense for repairs has been less than 1½ cents per square yard. On the compressed asphalt pavement laid by the Neuchatel Paving Company on Pennsylvania avenue between First and Sixth streets the repairs are reported to have cost about $1,867, or $622.33 per annum, the number of yards being 25,322.28. The annual expense for repairs has been about 2½ cents per square yard. This pavement of the Neuchatel Company is of the same character as those laid on the roadways in Paris. It is composed of *natural* bituminous limestone, which is broken and reduced to powder by heat, placed on the street in form of powder, and compressed by large iron rammers. The pavements which we are now laying in this city, under the name of asphalt, are *artificial* mixtures or mastics. Our investigations and practice are therefore on an entirely different line from those in Paris. The objections made to the Paris pavements are well known to be its slipperiness during a light rain or in damp weather, and the difficulty of cleaning. The contracts for maintenance provide for sanding the pavement when slippery, and for flushing it with a large amount of water and scrubbing with a rubber mop or "squeegee" in order to clean it. The same objections apply to the compressed asphalt pavement on Pennsylvania avenue, *while the mastics as laid here are almost free from these objections, owing to the gritty nature of the sand, which forms a large portion of the ingredients.* Where cut by plumbers, for making connections with pipes and sewers, *the surface coat does not show any appreciable wear.* The pavements are all to be repaired at the contractor's expense during the period of five years from date of completion, but as yet no repairs have been necessary except for cuts made by plumbers.

The entire surface of asphalt pavements on a concrete base in this city on the first of January, 1881, will amount to 360,000 square yards; of the so-called concrete pavements, of which the cementing substance was a product of coal-tar, the amount is 700,000 square yards, giving a total of 1,060,000 square yards of monolithic or smooth surface pavements, extending over a length of 44 miles. This is considerably more than exists on the roadways of all other cities in the world taken together—the amounts for other cities being as follows:

	Square yds.	Miles.
Paris	370,000	19¾
London	150,000	6½
New York	20,000	1
Other cities (estimated)	60,000	2¾
	600,000	30

The so-called *concrete pavements* are, as a general rule, in a fair state of preservation; they are generally laid on a base of broken stone from 4 to 6 in. thick, covered with a layer of "binder" about 1 in. thick, composed of pebbles and a cement of coal-tar. The wearing surface was made in various ways according to the patent, but consisted essentially of small gravel, sand or stone dust, cemented by a product of coal-tar. In the later pavements of this variety a certain proportion of asphalt was mixed with the coal-tar, and with beneficial results. Several of these pavements have stood the test of five years' wear, with little or no repairs, and are today in perfect condition; others were of inferior quality. When the top surface has worn off, these pavements begin to go to pieces very rapidly, and in order to save them from destruction they must be promptly covered with a new wearing surface. During the year 1879-'80, 53,436 yards were thus resurfaced; and 17,863 yards were entirely condemned, taken up and replaced with the standard asphalt pavement on a concrete base. During the current year about 15,000 yards have been resurfaced or are under contract.

Experience has, however, shown that by careful attention and constant repairs of small quantities in each, these pavements can be made to last much longer than was anticipated. Pavements, for example, which seemed on the point of destruction two years since, have by constant patching been maintained up to the present time and still present good surfaces. These pavements, however, were all laid within a few years of each other, and there is a possibility that after a few years more of wear they might all break up at the same time, during a severe winter, for example. It is, therefore, economical to gradually resurface a certain por-

tion every year, and an appropriation of about $100,000 should be made annually for this purpose. A summary of these pavements is shown in the following table:

	Square yards.	Cost.
Laid, 1871–'75	741,415.44	$2,284,004.91
Resurfaced, 1875–'78	218,842.69	329,378.69
Resurfaced, 1878–'80	53,436.33	59,187.40
Replaced, 1879	17,863.75	29,691 90
Minor repairs, 1875–'78		3,099.62
Minor repairs, 1878–'79		18,618.22
Minor repairs, 1879–'80		8,206.26
Total for repairs		448,182.09

These repairs extend over a period of seven years, *i. e.*, from 1873, the average time of laying, to 1880, and the average annual expense of repairs is, therefore, $64,026, or at a rate of 8½ cents per yard. This is certainly not an expensive rate for the luxury of smooth pavements. The asphalt pavements being composed of less perishable materials and being laid in a more substantial manner, it may be confidently expected that the cost of maintenance will be still less.

The minor repairs of concrete and asphalt pavements are made by contract let to the lowest bidder, and running for one year. These repairs include the damage done to pavements by plumbers' cuts, the actual cost of which is paid by the plumbers. The work to be done is specified by this office, and the whole city is carefully examined and repaired about four times a year, or oftener, if necessary. The work is done under careful inspection of experienced inspectors employed by the District.

RADIUS OF GYRATION.

Clarke, Reeves & Co., with most commendable liberality, caused some 20 of their Phœnix columns, full sized, to be experimented upon in the United States government testing machine at Watertown arsenal up to their breaking strain, observing the limit of elasticity, etc. The results were read at the last annual convention and given to the American Society of Civil Engineers, and elicited a discussion in which a large number of its members participated. When it is stated that Bouscaren, Cooper, Whittemore, Emery, Wood, Strobel, Wurtell, Burt, Merriman, Gates, Howard and F. C. Clarke were of the number, it will be perceived that much interest will be attached to the papers contributed by these gentlemen. They are published in the last number of the Transactions issued by the Society, the February and March numbers being embraced in one publication. Space will not permit a review even of the points made by these several engineers, but in the interest of such of our readers as possibly wedded to the oldest and approved forms have not looked for new light in which to read the truths wrested from nature, we make an extract from Mr. Theodore Cooper's paper as showing the derivation of the generally received formula (Gordon's), and its comparison with a more modern one, and the circumstances under which the latter is entitled to the greater credit.

The results of these full-sized experiments show that Gordon's formula does not express the true strength of these columns, and it would appear that separate formula would be desirable for long and short columns below 15 diameters, a result indicated by Hodgkinson. The Phœnix columns are stronger than Gordon's formula indicates.

The experiments upon Phœnix columns made at Watertown Arsenal are a valuable addition to our stock of knowledge upon well-made columns of varying dimensions.

The well-known Gordon's formula—

$$\frac{P}{S} = \frac{36{,}000}{1 + \frac{l^2}{3{,}000\ h^2}} = \text{crippling strain per sq. inch,}$$

which has been generally assumed as the standard of strength for all wrought iron columns with square ends, had its numerical constants derived from a series of experiments made by Mr. Hodgkinson upon small bars and plates, whose cross-section varied from 1 in. square to that of a rectangle 5¾ in. × 1 in. * * * * * * * * *

Though the formula was only intended to represent the strength of columns with a solid square or rectangular section, it has been generally applied to columns of all shapes of cross-sections.

The general form of the above formula was derived in the following manner:

The direct crushing upon any section of a column is represented by

$$\frac{P = \text{total load.}}{S = \text{Sectional area,}} \qquad (1.)$$

Any tendency to bend of a flexible column, free at the extremities, would increase the above crushing strain upon the concave side of the column, and relieve it upon the convex side. Analysis has shown that this increased strain due to the bending is theoretically equal to $\frac{P l^2 \lambda}{\pi^2 I}$ for the section at the center of the column $= \frac{P l^2 \lambda}{\pi^2 S r^2}$ (2) where P = total load on column, S = sectional area.

l = length, I moment of inertia, and λ the compression per square inch for a unit's length. This is identical with the formula for limiting strength given by Euler for long flexible columns which fail solely by flexure $P = \pi^2 \frac{E I}{l^2}$, if we reduce by substituting for E, modulus of elasticity, its value $\frac{f}{\lambda}$, f being strain per square inch due to bending only.

Summing equations 1 and 2 for total strain f, and representing the numerical quantity $\frac{\lambda}{\pi^2}$ by the constant a we get

$$\frac{P}{S} = \frac{f}{1 + a \frac{l^2}{r^2}} \qquad (3) \text{ Rankine's formula.}$$

Or for rectangular columns only

$$\frac{P}{S} = \frac{f}{1 + a' \frac{l^2}{h^2}} \qquad (4) \text{ Gordon's formula.}$$

r being radius of gyration and h least side of rectangle.

From the experiments of Hodgkinson upon small bars and plates of wrought iron Gordon determined the value of a to be $\frac{1}{3000}$ for square-ended columns.

Rankine from the relation

$$\text{Mom. Inertia of a square} = \frac{S h^2}{12} = S r^2 \text{ or}$$

$$h^2 = 12\, r^2 \text{ or}$$

$$\frac{l^2}{3{,}000\ h^2} = \frac{l^2}{36{,}000\ r^2}$$

converted Gordon's factor into 36,000 for his own formula.

The numerical factors being obtained from the same experiments, both formulæ should be equally true for square or rectangular solid columns.

For any other form of column, Gordon's formula cannot be considered as applicable. Rankine's being of a more general form should be more nearly correct, and from the closer coincidence of the results obtained by Mr. Bouscaren, we are reassured of its greater correctness.

It, however, has not been generally used, no doubt from the apparent difficulty of obtaining the radius of gyration of various sections. This, however, can be readily overcome by substituting in the Rankine's form the average value for the radius of gyration of each particular form of cross-sections in terms of the least side or the diameter.

The relation existing between the least dimensions and the radius of gyration of the usual sections is given as follows:

Cross Section.	$r^2 : h^2$.	$r : h$.	Comparative value of l^2 for use in Gordon's Formula.
Solid Rectangle	$h^2 = \frac{h^2}{12}$	$h = 3.46\ h$	1 / 3000
Box Column	$h^2 = \frac{h^2}{6}$ approx.	$h = 2.45\ h$ approx.	1 / 6000
Open Col. of Channels	$h^2 = \frac{7.3}{A^2}$	$h = \frac{2.7}{A}$	1 / 4050
Solid Circle	$h^2 = \frac{16}{A^2}$	$h = \frac{4}{A}$	1 / 2250
Hollow (thin) Circle	$h^2 = \frac{8}{A^2}$ approx.	$h = \frac{2.82}{A}$ approx.	1 / 4500
Phœnix Col.	$h^2 = \frac{7.5}{A^2}$	$h = \frac{2.75}{A}$	1 / 4750
Cross +.	$h^2 = \frac{24}{A^2}$	$h = \frac{4.9}{A}$	1 / 1500
Amer. Co.'s Col.	$h^2 = 11.6$	$h = 3.4$	1 / 3100

The fractions in the second member of the equations, under the third column, represent the comparative lengths of columns of different cross sections of equal strength. For example, the relative length of a Phœnix column and an American Company's column of the same strength would be as $\frac{1}{2.75} : \frac{1}{3.4}$, or as 34 diams. is to 27½ diams.

This shows the importance of referring to the ratio of the radius of gyration instead of trying to compare by the ratio of diameters between columns of such unequal resisting capacity.

CORRESPONDENCE.

WHY IS IT?

The radius for a 1° curve is 5,729.65 ft., and the radius of a 10° curve is laid down at 573 69 ft. Why is not 572.97 ft., or rather, why is not 5,729.65 divided by the number of the degree for which one wishes to find the radius?

NIMROD.

PERSONAL.

W. B. KNIGHT has been appointed City Engineer of Kansas City, Mo.

J. Q. BEARD has been appointed Chief Engineer on the Chicago, Goodland & Southern Railroad, now being built.

J. J. SHIELDS is Chief Engineer of the Atlantic, St. Johns & Indian River Railroad, headquarters at St. Augustine, Fla.

THOMAS GRAHAM, JR., is Chief Engineer of the new East River Railroad, with headquarters at Pearisburgh, Giles County, Va.

C. S. MASTEN has recently been made Division Engineer of the Western Division of the Wabash Railway, in charge of bridges and buildings.

AT the meeting of the Institution of Civil Engineers (London), on March 7, J. James R. Croes, C. E., of New York City, was elected a member of the Institution.

COL. JAMES MCCLURE, of Niagara, has been appointed Chief Engineer of the Buffalo, Tonawanda & Pine Creek Railroad, and will commence the surveys immediately.

MR. JOHN DUNN, for many years in the employ of the Illinois Central Company, and for some time Assistant Secretary, has been appointed Vice-Consul for Great Britain in Chicago.

Mr. JOSEPH ROBINSON has retired from the firm of Benj. Pike's Son & Co., manufacturers of fine engineering, surveying and mining instruments, 928 Broadway, this city. The firm name will be continued as heretofore.

A Philadelphia dispatch of the 27th says: Rudolph Hering, the civil engineer of this city, left for Cleveland yesterday, where he has been engaged to make a critical examination of the sewerage system of that city. He will be absent two weeks.

ENGINEERING STAFF MEXICAN CENTRAL. — The following named are the officers of the engineering department of this road: Chihuahua Division, located at Paso del Norte, Mexico, Geo. W. Vaughn, Chief Engineer; C. G. Vaughn, Office Engineer; M. D. Parlin, principal Asst. Engineer; J. E. Cunningham, Chief Draughtsman. This list may be of assistance to some wishing to correspond with these officials. All mail should be addressed El Paso, Tex.

Under Necrology in the last annual catalogue of Rutgers College (1881–82) we find a notice of the late Benj. D. Frost, C. E., compiled by Prof. Hasbrouck from data furnished by a near relative. As it is an accurate and concise account of the many works accomplished by Mr. Frost we present it to our readers in full:

BENJAMIN D. FROST was born at Wayland, Mass., Aug. 10, 1830, and died at St. Louis, Mo., July 19, 1880. He was graduated in the class of 1845 with high rank. The following year he passed in a further course of liberal study as a resident graduate at Harvard University, Cambridge, Mass. At the conclusion of the year so spent, he commenced under Samuel M. Felton, a celebrated civil engineer, a course of study and practice in preparation for the profession of his choice. In 1850, while engaged in the office of the Chief Engineer of the Baltimore & Ohio Railroad, not then completed, his ability and fidelity so commended him to his chief that he was placed in charge of a difficult section of construction, known as the "Pettibone Tunnel." Then followed a busy life of professional work on the Alexandria, London & Hampshire Railroad, in Virginia; the Sunbury & Erie in Pennsylvania; in Maryland, Wisconsin and North Carolina. He was later employed on the Kansas City Bridge over the Mississippi River; in Central Park, N. Y. City; in surveys and studies for Prospect Park, Brooklyn, N. Y.; on the work preparatory to the construction of the aqueduct at Washington, D. C.; on harbor work at Boston, Mass., and in numerous minor undertakings of similar character. With the experience and skill thus acquired, he was selected as State Engineer of the Hoosac Tunnel, a work of national interest and importance. He continued in charge of this enterprise for eight years, until its completion in 1876. In 1879 he accepted his final commission from the United States Government, conducting the surveys of the Mississippi River. While engaged in this work he was attacked by the malarial disease prevalent in that locality, and in the midst of hope and high endeavor was suddenly lifted out of labor into rest.

His reputation among those of his profession was deservedly high; his name will remain for-

ever identified with some of the greatest engineering problems of his country, while his memory will ever be honored by his superiors, to whom he was faithful, and by his subordinates, to whom he was always helpful and considerate.

ENGINEERS' SOCIETIES.

AMERICAN SOCIETY OF CIVIL ENGINEERS.

The following papers were published during the past year, some of which will be discussed at the Washington Convention:

CCXXII. (*June.*) Annual Address at Montreal, June 15, 1881: James B. Francis.

CCXXIII. (*July.*) The Re-enforcement of the Anchorage and Renewal of the Suspended Structure of the Niagara Railroad Suspension Bridge: L. L. Buck.

CCXXIV. (*July.*) The Flow of the Sudbury River, Massachusetts, for the years 1875 to 1879: A. Fteley.

———(*July.*) Discussion on Rainfall and Flow of Streams.

CCXXV. (*August.*) Comparative Economy of Steel Rails with Light and Heavy Heads: Ashbel Welch.

CCXXVI. (*August.*) Quicksand in Excavation: Charles L. McAlpine.

CCXXVII. (*September.*) Repairs of Masonry: O. Chanute.

CCXXVIII. (*September.*) Strength and Ductility of the Copper-Tin-Zinc Alloys: R. H. Thurston.

CCXXIX. (*October.*) Shaft Sinking under Difficulties at Dorchester Bay Tunnel, Boston, Mass.: D. McN. Stauffer.

CCXXX. (*November.*) Sewerage Systems: Rudolph Hering.

CCXXXI. (*December.*) On Uniform Standard Time, for Railways, Telegraphs and Civil Purposes Generally: Sanford Fleming.

CCXXXII. (*January*, 1882.) Experiments upon Phœnix Columns: Clark, Reeves & Co.

CCXXXIII. (*February–March*, 1882.) Discussions on Wrought-Iron Columns, Tests and Formulæ.

The following papers, not yet published, are also open for discussion. Proof slips of these will be prepared for issue as soon as possible:

A Note upon the recent Railroad Crossing Case at Elmira, N. Y., with reference to the hydraulic questions brought forward: William R. Hutton.

The Averaging Machine: W. S. Auchincloss.

On the Removal of Incrustations in Water Mains; a description of the operations performed in Halifax, N. S., Canada: E. H. Keating.

The Mean Velocity of Streams Flowing in Natural Channels: Robert E. McMath.

The Overflow of the Mississippi River: Lyman Bridges.

On the Mode of Underpinning adopted for the Croton Lake Bridge, New York City and Northern Railroad, during the Repairs of the Masonry Piers: Alfred P. Boller.

TESTS OF STRUCTURAL MATERIALS.

Note.—The following memorial has been prepared by the Board of Direction of the American Society of Civil Engineers under instructions of the Society in annual meeting, January 18th, 1882. It has been signed by the President and Secretary in behalf of the society, and presented to the Chairman of the Committee to which the bill to appoint a Commission of Experts to test Structural Materials (House Bill 4,726), has been referred.

John Bogart,
Secretary Am. Soc. Civil Engineers.

The Memorial of the American Society of Civil Engineers respectfully represents:

That pursuant to authority given by an act of Congress approved March 3d, 1875, the President of the United States appointed a Board to test the strength and other qualities of iron, steel and other metals, such as are used for constructive and mechanical purposes; that a testing machine, believed to be the best in existence, has been constructed and is now ready for use at the Watertown Arsenal; that the said Board made many tests and obtained much information of great value; that said Board expired by limitation of law, leaving much important work yet to be done.

And your memorialists further represent that it is of great importance to the public safety as well as to the economical use of materials by builders and manufacturers, and by the Government itself, that iron, steel and other materials, used in bridges, buildings and every kind of structure, should be carefully tested for the following among other reasons:

The tests of materials heretofore made, both in Europe and America, have commonly been of small specimens, from which, owing to the different circumstances of manufacture and shapes of the specimens, the strength, elasticity and other useful qualities of large specimens of the same materials cannot be accurately inferred, and therefore it is necessary to test those larger specimens, especially the members of bridges, buildings and other structures, of the sizes and forms in actual use. New processes of production of iron, steel and other materials have come, and are still coming into use, the products of which vary very considerably from the products of older processes, and it is therefore important, both for safety and economy, that they should be tested. The real margin of safety of any member of a structure is not the difference between its actual load and the load that would break it at once, but between its actual load and the heaviest load that would not practically impair its strength by overtaxing its elasticity. To ascertain this, particularly for the full-sized members of structures, requires the use of this largest and most accurate of testing machines by skillful experts, who should personally make these tests and investigations, and place the results in such a practical form as will serve as a safe guide to every person engaged in construction, or in the manufacture of materials for construction. The absence of reliable knowledge of this character has doubtless contributed to, if it has not been the sole cause of, some of the most serious failures of structures, otherwise in no respect faulty, whereby many lives and much property have been sacrificed.

From these and other considerations it will be seen that the public safety, as well as the economical use of materials by the Government and by builders, imperatively demand more thorough tests and on a larger scale than most of those heretofore made.

And your memorialists further represent that there is no prospect that the necessary tests will be made without the aid of Government. Should private manufacturers or builders test their own materials, they might not give the public the benefit of their experiments; such experiments would not have that assurance of impartiality and that high authority which those made under the authority of the Government would have. Experiments conducted by private parties would be so different in the objects, methods and circumstances of applying tests as to render it impossible to properly collate and verify them; they would, therefore, be of comparatively little value in ascertaining accurate general results.

Associations, such as your memorialists, have not the means to defray the expense of such investigations.

Wherefore your memorialists pray your honorable bodies to authorize the President of the United States to appoint a Commission from among men skilled in the investigation, production and use of metallic substances and other structural materials, who shall plan and execute the needed tests and experiments on iron, steel and other materials in extensive use in bridges, buildings and mechanical structures, and deduce useful rules therefrom.

And your memorialists further pray that such appropriation be made as may be required to improve, if necessary, the testing machine before mentioned, and as may be required to secure the services of experts of the highest ability and to pay the expenses of experiments.

A BILL.

Authorizing the President to appoint a commission of experts, skilled in the investigation, production and use of metallic substances and other structural materials, to execute tests and experiments on iron, steel and other materials, used in the construction of bridges, buildings and mechanical structures, and deduct useful rules therefrom.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled:

Sec. 1. That the President of the United States be and he is hereby authorized to appoint a commission of seven members selected from among men skilled in the investigation, production and use of metallic substances and other structural materials, to hold their appointment during the pleasure of the President of the United States; which commission shall plan and superintend the execution of such tests and investigations of materials used extensively in the construction of buildings, bridges, ships and other structures and machinery, as it shall think most important to be made, and from time to time publish results of the tests and investigations, and also such scientific principles and such practical rules deduced therefrom as it shall consider most useful. The said commission shall organize itself, and adopt such rules, and make such assignment of duties among its members as it shall deem most promotive of the object of its appointment. Vacancies occurring from time to time in said commission shall be filled by the President of the United States.

Sec. 2. That the said commission shall report its work with its results and the deductions made therefrom, annually to the Secretary of the Interior, and its accounts shall be settled in the Interior Department, through such channels as the Secretary shall direct.

Sec. 3. That the members of said commission shall be entitled to mileage and other necessary expenses incurred in the prosecution of their duties, but no salaries as members of the commission.

Sec. 4. That the said commission is hereby authorized to appoint a principal expert who shall personally conduct the examinations and tests which the commission shall direct, with such assistants and laborers as may be necessary, and also to purchase such material for test and investigation as may from time to time be required.

Sec. 5. That this act shall take effect immediately.

LIVERPOOL ENGINEERING SOCIETY.

The fortnightly meeting of this society was held at the Royal Institution, on Wednesday evening, Mr. F. Salmon, President, in the chair, when a paper was read by W. James Morgan, on the construction of Impervious Street Pavements, with special reference to the methods practiced in Liverpool. In introducing the subject, the writer stated that previous to 1872 impervious pavements had no existence in Liverpool, and although the late Mr. Newlands, in his published report to the Health Committee in 1848, strongly recommended on sanitary grounds the construction of pitch jointed impervious pavements. No action was taken for 24 years, when the carriageway on North John street was reconstructed. The obvious advantages of the system soon became so apparent that at the present time there are within the city not less than 650,000 superficial yards of impervious pavements, all laid within nine years by the workmen of the corporation. This work has mainly been carried out in business streets and leading thoroughfares, but the writer urged the importance of extending the system more generally to the back streets in the densely populated parts of the city, to the entire abolition of bowlder paving, with its filth holding joint. The writer then described in detail the construction of the various classes of pavements and concrete foundations laid in Liverpool, exhibiting specimens of the material used in the work. In referring to wood pavements the author remarked that, though the use of wood as a paving material has been strongly advocated of late years by tradesmen in busy thoroughfares, where the continuous din of city traffic is a great hindrance to the carrying on of their business, and a noiseless pavement would be a boon, yet want of knowledge and carelessness in its construction have prevented it from receiving the encouragement from engineers that it undoubtedly deserves, though next to macadam the most expensive pavement to maintain. Yet this excessive cost is counterbalanced by the comfort and quietness afforded in thoroughfares where these conditions are essential to the carrying on of business.

A discussion followed the reading of the paper, and on account of the interest and importance of the subject the discussion was adjourned till the next meeting of the Society, to be held on April 26.

A vote of thanks was accorded to the author for his interesting paper.

RECENT INVENTIONS.

ELEVATED WAY.

This invention consists of a car traveling upon a fixed cable arranged between two points. The cable is stretched between two suitable supports, and secured by a strap provided with rollers adapted to travel on a vertical frame secured to the supports. The cable is raised or lowered at either end by means of a cord passing over a system of pulleys and attached to the straps, and having at one end a weight, and at the other a shaft adapted to operate the device. This mechanism simultaneously changes the relative vertical positions of the ends of the cable, so as to cause the suspended car, by the action of gravity, to automatically pass from one end of the cable to the opposite one.

PNEUMATIC ELEVATOR SYSTEM.

This novel improvement contemplates a number of pneumatic elevators to receive their power from a common central supply of compressed air. The central station has an air-compressing apparatus, and one or more extensible and compressible air holders or reservoirs located thereat. Pipes convey air from the compressor to the reservoirs. A main conducts air away from the central station, to each of the outlying distant elevator stations. Each of these elevators is provided with an air engine or motor connected with the main air-duct, to operate the elevator. A pipe permits air, on the downward movement of the elevator, to escape, and this escape may be used for ventilating purposes, etc.

SUPPORT FOR FIREMAN'S HOSE.

This late improvement consists of a hook which is secured to a threaded ring surrounding the nozzle near its juncture with the pipe. This hook is adapted to engage the round of a ladder, and is held in position by a catch.

CHAIN PUMP.

This improvement consists in the novel arrangement and construction of a flexible lining within the bore. The chain-pump tube has the usual cylindrical bore. It is provided with a lining of

rubber or other elastic or flexible material, so that a closed or water-tight space is interposed between the lining and pump tube to allow said lining to adjust itself to the unevenness of the buckets.

AUTOMATICALLY DUMPING AND RIGHTING ELEVATOR-BUCKET.

This improved hoisting-bucket suspended upon pivots on its opposite sides, located at such a point as to be above the center of gravity of the empty bucket and below the center of gravity of the loaded bucket, whereby the loaded bucket, when released from its latching devices, will automatically dump and empty itself, and when emptied the bucket will automatically return to and latch itself in an upright position.

RAILWAY SWITCH OPERATING DEVICE.

In this improvement the switch-operating rod which extends to the distant lever carries guides, through which slides the switch-operating bar. A hand lever is pivoted to the bar, and to links secured to the guides, whereby the switch may be operated independently of the distant lever. To prevent restoring the connection when the switch is wrongly set, a chain with a securing padlock is employed. When being operated by hand the weighted hasp falls in front of a stop-plate and prevents movement by the distant bar.

ROAD LOCOMOTIVE.

This locomotive, for ordinary roads, consists of a boiler supported upon a front pilot wheel and rear driving wheels. The cylinders are secured to the underside of the boiler, and the crank or engine shafts work pinions which mesh with gears on the drive wheels. The pilot wheel is supported upon a saddle, recessed on its edge and fitting into a ring secured to the boiler, and is operated by a rod and lever connection from the cab.

WASHINGTON, D. C. F. B. BROCK.

IMPROVEMENT OF THE MISSISSIPPI.

The minority report of the Mississippi River Commission, prepared by Captain James B. Eads, was obtained from him by a *Tribune* reporter on the 24th. The report has just been completed and has not been published. Captain Eads dissents from the recommendation of the majority report for the construction of a sill to interrupt communication between the Mississippi and Atchafalaya rivers. He urges the immediate construction of a sill in the Atchafalaya, near its upper end, to diminish the volume of water flowing through that outlet, and from year to year, as rapidly as may be deemed safe, the building up of the sill until it shall finally constitute a dam, completely separating the river from all communication with the Red and Mississippi rivers. The result of this will be, he says, to increase the volume flowing in the main river and improve the depth of water on bars below the Red River, on which, at low water, there is now only a depth of ten feet. The minority report also opposes the proposed improvement of the harbor of Vicksburg by reveting Delta Point against further erosion, and by dredging out a basin and a channel leading to the harbor, by which steamers will have access to Vicksburg landing. He favors an artificial extension of Delta Point to a sufficient distance to throw the channel against the old landing at Vicksburg. "Approximate estimates made by me," says Captain Eads, "show that this can be accomplished for $1,200,000 and deep water permanently secured at the Vicksburg wharf without further outlay for maintenance. Two hundred and fifty thousand dollars could be profitably expended upon this work during the ensuing year."

The main part of the minority report, however, is devoted to advocating the immediate closing of the present gaps in the Mississippi River levees, as an important factor in the contemplated plan for the improvement of its low-water navigation. Observations made by the Commission, Captain Eads holds, plainly show that these gaps have had the effect of raising the river's flood-line many inches above any height previously attained within the 700 miles in which they exist most numerously, between Natchez and the mouth of the Ohio. The deposits from the crevasses have raised the bed of the river so much as greatly to injure navigation. Captain Eads describes at length the physical formation of the lower or main alluvial basin of the Mississippi, and the land-building process resulting from the deposits of sedimentary matter when the river at flood tide escaped over the banks of its channel. The loss of current in the water thus escaping caused the sandy or heavier parts of the solid matter held in suspension in it to settle almost immediately on the submerged banks, while the argillaceous and lighter parts, taking longer to settle, were carried back by the feebler current to the swamps or lower lands, on which they were deposited over a much more extensive area. As the loss of volume over the natural banks produces a more sluggish current in the main channel, thereby causing a greater deposit of sediment, the bed of the stream, as well as the banks, was built up higher and higher during each successive flood. Occasionally the conditions were such as to cause the stream to forsake entirely its old channel, and the elevation of its banks and bed above the adjacent lands enabled it to send its earthy matters many miles away, so that every part of the basin was covered with its deposits.

Captain Eads' report says in substance that levees, by restraining the floods within the defined channel of the river, stop the land-building process. It is an error to suppose that rivers confined by levees have a tendency to have their beds elevated and in consequence to need a corresponding elevation of the levees. Three principles control the phenomena of sedimentary streams flowing in channels made through their own deposits —first, the force producing the current, resulting from a fall from a higher to a lower level; second, the frictional resistance of their beds; third, the dependence of the quantity of sediment carried in the water upon the velocity of the current. The normal velocity of a current cannot be permanently increased by man. By securing a higher velocity of current from the retention of the whole volume of water within the levees, a greater amount of sediment will be transported. If that amount is greater than that which the tributaries contribute, it will be taken out of the bed to the benefit of navigation, and the flood line consequently will be lowered to such a degree as will finally reduce the excess of current which the increased volume has produced down to the normal velocity. The increase of volume which will be secured by the closing of the gaps in the levees will produce this increased current. The report contains the results of many observations and careful measurements of the Mississippi during the floods of 1851 and 1858. They prove, in Captain Eads' opinion, that it is entirely practicable to retain the entire flood discharge of the river within the present levees, if they are repaired, even without making them any higher. If the gaps are left open, he says, "new shoals and injurious changes in the channel will be occurring at other points of the river than those selected by the commission for immediate improvement, and these new obstructions and changes in the channel will require so much more additional work, and this will undoubtedly cost twice or thrice as much as it will to repair the levees. By repairing them the channel will not only be prevented from becoming worse at any point on the river, but the shoaling which has occurred as a result of these outlets will be removed by the effect of the levees, and the work of improvement can then be limited to the reduction of the excessively wide places which now exist and which are inclosed by the present levees. These wide places are the cause of cut-offs, caving banks, shifting channels and vexatious shoals."

USEFULNESS OF ENGINEERS' SOCIETIES.*

* * * I am a firm believer in the usefulness of such organizations. People devoted to kindred pursuits have naturally much in common, and such a society brings them together, not only professionally, but socially. It is the good fortune of our calling that there is not much personal rivalry or competition. The field is so large and capable of such great subdivision into specialties that there is room for all; and so the relations of practical engineers are rarely complicated by personal misunderstandings. At the same time each one, working in his own field (and the working engineer is always a busy man), is rather isolated from his brethren engaged in differing, but yet kindred pursuits. Such an organization as this brings them together occasionally, and so professional sympathies may ripen into personal and congenial regard and friendship. Doubtless, no one goes away from these meetings without feeling that the time has been pleasantly as well as usefully spent. But, after all, the great service is probably professional. Here are many bright and eager minds, devoted earnestly and laboriously to the various branches of the broad science of engineering. Each relates his special experience, nothing in which can fail to be of interest to all; and in the conversations and discussions which follow there is always substantial and suggestive nutriment. No profession is so widely subdivided as ours. In its broad sense, it is the *science and art of construction*, and so incloses within its ample limits a multitude of specialties, related and yet differing, connected and yet distinct; and any one of these specialties demands and must receive the best industry and ability of him who would worthily practice it. Rennie built docks, bridges, canals, light-houses, sewers, mills, and undertook mining and metallurgy. At the present day each of these branches has its own disciples and students. One mind cannot grasp so great a field; it is enough to be thorough in one sub-department.

And such a society as ours brings all together; and each one can learn from and profit by his neighbor. Surely, its motto might be "E Pluribus Unum."

To be called to the presidency of such a society is an honor to any one, and as such I gratefully accept it.

*From address of Willard S. Pope, President of the Western Society of Engineers. Reprinted from Journal of the Association of Engineering Societies.

SALT WITHOUT SAVOR.

The riddle which every man in the world tries to guess is, What is the secret of success? Why does ill-luck dog one man, who is not only good-looking and attractive but honest and hard-working, while a tricky, vulgar fellow with a plebeian brain, gains reputation, happiness and fortune? What peculiar quality is it in a man which enables him to get whatever object he sets before him as best worth having? Our middle-aged reader out of his experience can tell us that it is not genius which brings down the big prizes of life: nor talent and sharpness, however skilfully trained, the man born to money or influence does not always succeed, neither does the patient drudge, however hard he strive. Faith in God or the lack of it does not seem to affect the matter at all. He does not invariably reward His disciples with the fulfillment of their own pet plans: now it is the saint who is ahead in the race at college or in the world of trade, literature or society, and now the sharper. You cannot gauge a man's religion by the amount of his popularity or bank stock.

What is it, then? What is the secret which some men possess which forces difficulties out of sight and compels better and cleverer men than themselves to work for them; serve as rungs for their ladder to fortune? We think it will be found that all successful men have one peculiar trait in common. Each has had only a single aim in life, and has pursued it with an inexorable intensity of purpose, regardless of outside issues or consequences. In proportion as the aim is limited and in proportion as the whole man is absorbed in his direct purpose, he is likely to succeed. His object may be the preaching of the gospel, it may be the selling of a patent plough, it may be a great heroic truth or a gigantic swindle, but if he believes in it absolutely, if he shoulders it with fiery zeal, he will as a rule carry it through and compel other men to believe in it and shoulder it too; while if he lags along, half-hearted, uncertain, doubting it and himself, he and his cause will fall by the way.

Now every genuine young man begins his career with a flash of this hot live faith in his own business in the world. It may be a trade or profession, or a hobby or reform, or the greatest cause of all, the serving of Christ: but to him it is the one real thing that he knows. It is the life-saving boat and he is the pilot; it is the bridge just built across Niagara, and he is the engineer. But by the time he is forty the flash has died out. He begins to see that there are more pursuits in the world than one; the energy which, when pent in one channel by the intolerant bigotry of youth, flowed like a mountain torrent, oozes now through a thousand openings, broad, shallow and sluggish. Or he grows selfish; why should he risk his comfort and life in saving other people? It is enough for him to take care of wife and children without manning life-boats or building bridges over Niagara. With most of us, however, our occupation or errand into the world has lost interest and zest for the commonplace reason of too great familiarity. Ninety-nine out of a hundred of the men and women who crowd Broadway are in some kind of a rut, and a rut, like the tracks of the street-cars, though it makes pulling easier for the horse, is apt to return on itself; it leads nowhere. This is why the middle-aged doctor or lawyer jogs through his work without honor or profit; all he asks now of the noble profession which fired his ambition at first is to pay his bills. His pleasures lie outside of it, in his club, in art, in his dinner. This explains why, when artists or authors meet, "shop" is so often talked instead of the great truths which outsiders would expect to hear in a convocation of seers. This is why so many clergymen preach Sunday after Sunday dreary platitudes which drive men out of the pews and leave only the women, whose devotion is ardent enough to inform the dead words with life to their souls. It is not that his profession, his art or his religion is not dear to each of these men; but he is no longer in love with it. His brain is tired of looking at it closely. It has grown commonplace and dull to him. The salt has lost its savor. Hence it comes that the artist, the professional man, the clergyman, though they work far harder than at first, do not succeed. There is something lacking in the book, the picture, the sermon; it is without leaven; the world does not want it.

Now, how is this man to put life into his work again? The most sensible thing which a man can do, when his work grows to be only a load to be hauled in a rut, is to get out of his rut, step aside from it long enough to look at it with a stranger's eyes. It is the middle-aged man more than the boy who needs the long journey to California, to Europe, anywhere among new habits and new

peoples. If the artist or author would turn his back on his comrades and scramble on to some other level in life than that of his own trade, he would better see the possibilities of his work. If the clergyman would sometimes shut up his study, lay off his white cravat and all the prerogatives of his office, and go down and jostle and be jostled in the crowd, he would come to his pulpit with different perceptions of the devil's actual power over poor men and women, and of Christ's infinite mercy.

This kind of paralysis which we describe is becoming a chronic and universal disease among us. Change of air is a simple remedy; but it is the most effective.—*New York Tribune.*

THE NONPAREIL PLUMB-BOB.

As will be seen from the accompanying illustration this plum-bob consists of two separate parts—a square head piece and the pointed bob. The advantages of this over the old styles are apparent when it is considered that the peculiarly concave shaped point causes it to remain in the spot into

which it is dropped, and prevents it from waving in any direction. The square top keeps it steady and stationary along any wall or other perpendicular place to which it may be applied. The bulged or convex sides of the old patterns divided the weight of the bob so unevenly as to cause its point to move on the slightest change of position or touch, and making it difficult to steady the instrument wherever suspended.

The "Nonpareil" has been lately introduced by Messrs. Keuffel & Esser, of this city.

CONNECTICUT LEGISLATION.

The General Railway law of Connecticut has been amended by the General Assembly, just adjourned *sine die*, so as to make its provisions more liberal in several respects. The time for taking land has been extended from one to two years, and navigable waters may be bridged with the consent of the Railway Commissioners without an application to the General Assembly. The bridging of the Thames River at New London, which promised to be a hard fight, was adjusted by the passage of a bill leaving the whole matter to be determined by a Board of Engineers to be appointed by the War and Navy departments. The hottest fight of the session was over the charter of a parallel road between New York, New Haven and Boston; but the bill was defeated in the Senate after its passage by a large majority in the House. The New York & New England road has been given five years additional time for completing its lines, and has been authorized to issue $5,000,000 of bonds, and the Connecticut Western has been empowered to purchase or lease the Rhinebeck & Connecticut road, connecting with its line at Millerton, and giving it important control of freight business and passenger traffic from Hartford westward.

BRICKWORK UNDER PRESSURE.

During the construction of the tunnel under Dorchester Bay in Boston, it became necessary to construct a brick bulkhead that had to withstand the pressure due a water column 162 ft. high, and, as it was intended to shut off a leak amounting to 240,000 gallons per 24 hours, it had to be watertight. Mr. D. Stauffer gave the following description of this work before the Engineers' Club of Philadelphia:

The tunnel section at the point selected for the bulkhead was practically 10 feet square. The bulkhead was built directly across the tunnel, 50 feet in front of the heading where the water was struck. Plank dams filled with puddle clay were first thrown across the tunnel, each side of the bulkhead site, and a 6-in. wrought-iron pipe used to carry off the water during construction—the pipe being built into the brickwork. An arched form was adopted, 4 ft. thick at the crown and 2 ft. rise in a span of 10 ft. Hard-burned bricks were used, laid in mortar made of one part English Portland, one part Newark Rosendale, and two parts clean, sharp sand—a compound found equally strong with English Portland, and sand one to one, and having the advantage of working smoother on the trowel, and adhering better to brickwork in wet places. Skewbacks for the arch were roughly picked out in the rock at the sides. After the cement had set, the water was shut off by screwing a cap on to the outer end of the 6-in. cap. The pressure against the wall was 72⅕ lbs. per square inch, or about 519 tons distributed over the face of the bulkhead. The wall was tight for about 48 hours; then water came through the *brick* itself, rather than through the joints, in amount equal to one half the original volume. The water was let off and a second experiment tried. The main wall was torn down sufficiently to allow men to pass behind it, and a second wall only 12 in. thick was built back of the first, and two feet distant. The space between these walls was well rammed with puddle clay, extending to the rock on all sides. The second wall was made purposely light, as its yielding to the pressure would only more effectually consolidate the clay between it and the unyielding wall in front. The bond used in the main wall was one so laid that there were no continuous horizontal joints through the wall. The result of the last construction was to completely shut off the water from this leak, at a great saving of fuel and pumps. The Dorchester Bay tunnel is 7,000 ft. long, with its average invert grade 143 ft. below low-tide mark in the bay under which it passes. The tunnel is driven through a formation of clay, slates and conglomerates for its entire length; rock, very seamy, and much water encountered.

We may add that in mining bulkheads, which often must carry much greater pressures, the practice is to let the water rise slowly behind the bulkhead, by allowing a portion of the water to flow through a safety-valve at the bottom of the level. It has been the experience in all such cases that in the beginning quite a quantity of water will come through the pores of the brickwork, which is said to be "sweating." Gradually, however, the pores are filled by carbonate of lime, and a thick coat of that substance forms on the face of the bulkhead, completely cutting off the entire flow of water. A column of from 400 to 500 ft. has been borne for many years by such bulkheads. —*Engineering and Mining Journal.*

FLORIDA NOTES.

The Live Oak, Tampa & Charlotte Harbor Railway Company will build a branch to their main line from Suwannee County to Gainesville.

The Florida Central & Western Railroad Company has filed articles of incorporation. The road will run from Jacksonville to the Apalachicola River, with a branch from Tallahassee to St. Marks, and from Drifton to Monticello, all in the State. The road will be 23.4 miles long.

The Chattahoochee & East Pass Railway Company has been incorporated. The road will be about 65 miles long, and will be constructed between a point at or near Chattahoochee, in Gadsden County, to the waters of the Gulf of Mexico, at some point on the southern boundary lines of Franklin County, between the eastern and western boundary lines of said Franklin County, and will pass through or into the counties of Gadsden, Liberty and Franklin.

The incorporators and builders of the Southern Railroad, leading to Palatka and Gainesville and southward, have filed articles of incorporation in Tallahassee for the purpose of building a road from Palatka to St. Augustine.

The *Tampa Progress* of the 27th ult. said: "Last week was quite an interesting one in railway affairs in Tampa. The return of the engineer corps of the Jacksonville, Tampa & Key West, after completing their line of survey to Punta Rassa, and on the same day the engineer corps of the Live Oak, Tampa & Charlotte Harbor Railway camped at Two-Mile Branch, and several of the party came into town. They had completed their line to Gasperilla Island, and came back highly pleased with their route. Then on Friday the right-of-way party returned, having gone some 40 miles along the route of the Jacksonville, Tampa & Key West Railway, and secured the right of way without any material difficulty or obstacle presenting itself."

The Orange County papers notice the incorporation of several new companies. One is a company to construct the Apopka branch of the South Florida Railroad. This branch of railroad will be about 56 miles in length, and will be constructed from a point at or near Jackson's, on the main line of the South Florida Railroad, to a point on the Withlacoochee River, passing through the counties of Orange and Sumter. Another is the Kissimmee, Okeechobee & Gulf Navigation Company, its principal place of business at Sanford. The general nature of the business to be transacted by this company is the purchase, construction, operation and navigation of steamboats, steamships, barges and all manner of steam, sailing and other crafts on the Kissimmee River, Lake Okeechobee and Caloosahatchie River, to the Gulf of Mexico. Another company, to be known as the Suwannee & Santa Fe Railroad Company, will build a road from a point at or near Melrose, in the county of Clay, in said State, into or through the counties of Alachua and Lafayette, to some feasible point on the Gulf of Mexico, in said State of Florida. Still another road has been incorporated to build a road from Titusville, in Brevard County, on the Indian River, to Bartow, thence to Fort Meade, in Polk County, and thence to a point at or near the mouth of the Manatee River, in Manatee County, a distance of 150 miles.

Messrs. Palliser, Palliser & Co., of Bridgeport, Conn., have submitted plans for a court-house at Pensacola.

The city council of Jacksonville has passed an ordinance to regulate sewerage.

CONTRACTS FOR LIGHTING THIS CITY WITH GAS AND ELECTRICITY.

Mayor Grace, Controller Campbell and Public Works Commissioner Thompson, comprising the Gas Commission, met in the Mayor's office recently and awarded the contracts for lighting the city during the year, beginning on May 1. It was decided to light the Battery Park, City Hall Park, Broadway from Canal street to Fourteenth street, Washington square, and Fifth avenue from Washington square to Fourteenth street, with electricity, and a contract for that purpose was awarded to the United States Electric Light Company at the rate of 70 cents a lamp per night. It will take about 65 lamps to light the district. The Brush Electric Light Company was given a contract to light Broadway and Fifth avenue from Fourteenth street to Thirty-fourth street, Fourteenth street from Fourth avenue to Fifth avenue, Thirty-fourth street from Broadway to Fifth avenue, and Union and Madison squares. The price agreed upon was 70 cents a night for each lamp. The company is now lighting the same districts for 33⅓ cents a lamp. The Brush Company put in a bid to light High Bridge for $1 a lamp, but it was rejected because of the strenuous objections made by Controller Campbell. Other contracts were awarded as follows: New York Gas-Light Company, for the district south of Grand street, $17.50 a lamp per year; Manhattan Gas-Light Company, district between Grand and Thirty-fourth streets, $17.50 a lamp; Mutual Gas-Light Company, certain streets between Thirty-fourth and Seventy-ninth streets and the parks south of Thirty-fourth street, $17.50 a lamp; Metropolitan Gas-Light Company, district between Thirty-fourth and Seventy-ninth streets, $17.50 a lamp; Harlem Gas-Light Company, district north of Seventy-ninth street and south of Spuyten Duyvil Creek and the Harlem River, $19.50 a lamp; Central Gas-Light Company, Twenty-third Ward, $29 a lamp; Northern Gas-Light Company, that part of the Twenty-fourth Ward formerly the village of West Farms, $32 a lamp; Yonkers Gas-Light Company, the remainder of the Twenty-fourth Ward, $30 a lamp.

HANNIBAL, TERRE HAUTE & INDIANAPOLIS RAILWAY CO.—The survey of this road lately ordered by the corporators, under the leadership of the President, George M. Edgerton, and the Treasurer and Secretary, D. M. Edgerton, of St. Louis, has been in progress for some weeks, conducted by W. T. R. Fennessey, as Chief Engineer, and J. B. Moulton, Consulting Engineer. It traverses a southeasterly course, from the Hannibal Bridge over the Mississippi River, through the counties of Pike, Green, Macoupin and Montgomery, stopping for the present at Pana, in Christian County, Ill., where it will intersect the Illinois Central and the Illinois & St. Louis railroads, 94 miles from St. Louis. In Pike County it crosses the Louisiana Branch of the C., B. & Q. Railway and the Louisiana branch of the Wabash. In Green County it will cross the Jacksonville branch of the Chicago, Alton & St. Louis Railroad. In Macoupin County it will cross the main line of the last-named road and the newly-constructed St. Louis, Jerseyville & Springfield Railroad, now in the Illinois Wabash system. Length of road to Pana, about 125 miles. As soon as the right of way is secured from Roodhouse to Pana, construction will be commenced. The country this road passes through is not surpassed in farm products in the great State of Illinois, and its direction makes a valuable cut-off in the direction of Kansas City.

THE MISSISSIPPI RIVER APPROPRIATION.

The Senate has passed the Mississippi River Improvement Bill. It directs the Secretary of War, with the advice and under the direction of the Mississippi River Commission, to expend $6,000,000 ($5,000,000 on the Mississippi and $1,000,000 on the Missouri) in deepening the channels and improving the navigation of these rivers in accordance with plans recommended by the commission.